IBM

Customer Engineering Manual of Instruction

PRELIMINARY EDITION

CARD PUNCH, TYPE 24

PRINTING CARD PUNCH, TYPE 26

INTERNATIONAL BUSINESS MACHINES CORPORATION
NEW YORK, NEW YORK

Printed in U. S. A.
Form No. 22-8319-0

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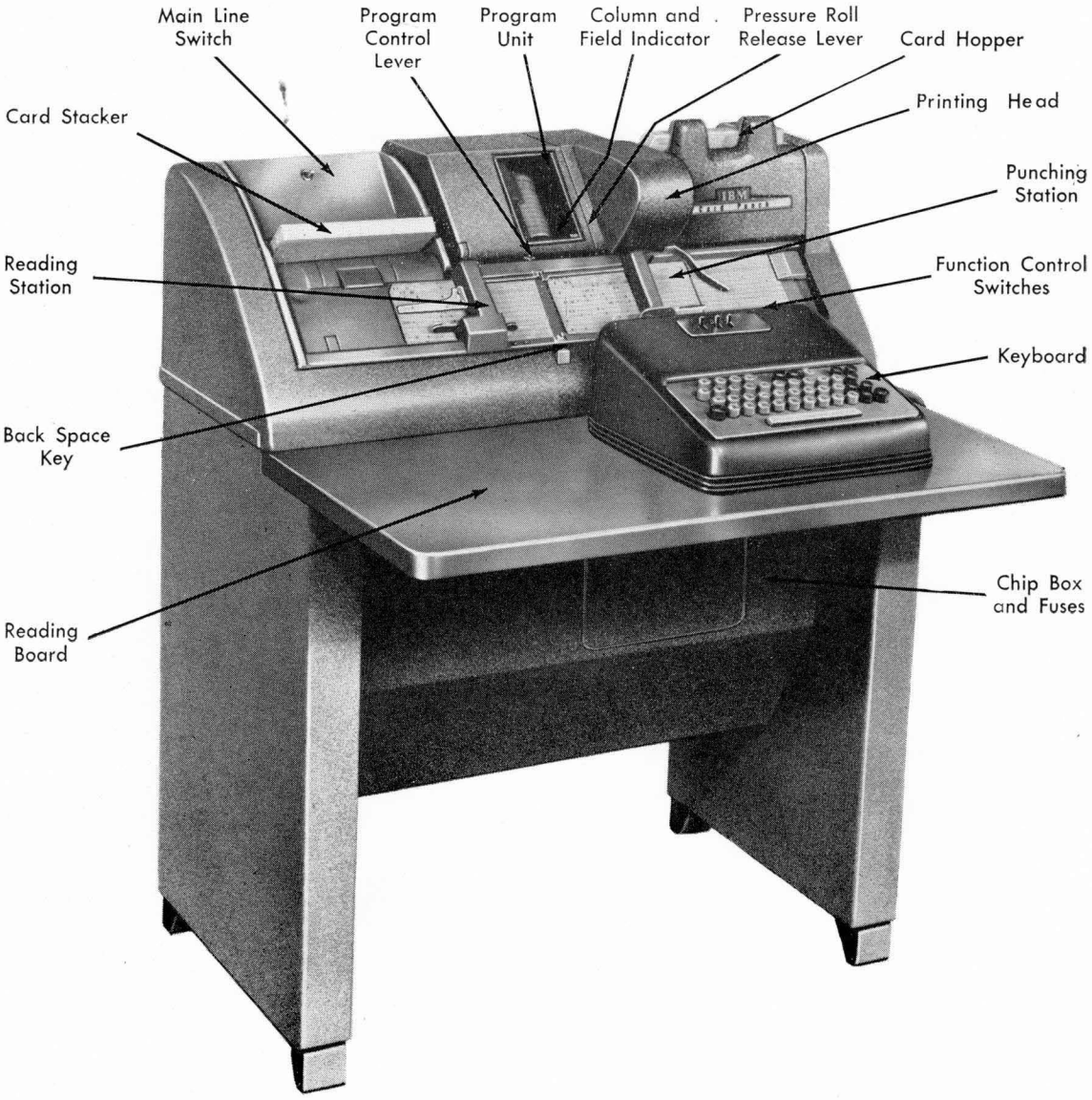


IBM PRINTING CARD PUNCH
Type 26

CARD PUNCH, Type 24
PRINTING CARD PUNCH, Type 26

FUNCTIONAL PRINCIPLES

THE BASIC operating unit in IBM Accounting is the IBM card. IBM Card Punching Machines are used to transcribe information from the original documents to IBM cards—the operating units for all subsequent machine operations. Punching, therefore, is the first step in the IBM Accounting method.

The second step in the method is the sorting of cards into similar groups and arranging them in sequence for report preparation. In the third and final step, the printed reports are prepared from punched IBM cards. Because the printed reports can be no more accurate than the cards from which they are prepared, the accuracy with which the IBM cards are punched is of utmost importance.

The Type 24 Card Punch and the Type 26 Printing Card Punch are designed to handle the types of accounting data which include not only quantitative data expressed in numbers, but also identification data expressed alphabetically.

In addition to recording information by the usual means of punched holes in IBM cards, the Type 26 Printing Card Punch is designed to print this punched information along the top of the card. This printed information appears in the column directly above the punched holes it interprets, therefore, it is possible to print 80 columns in one card operation.

To record an alphabetic character, two holes must be punched in each column, a zone punch, 0, 11, or 12, and a numerical punch, 1 through 9. Of the 27 possible combinations of these 3 zone positions and 9 numerical positions, all except the 0-1 combinations are used for the 26 letters of the alphabet. A is a combination of 12 and 1, B of 12 and 2, C of 12 and 3, etc. The following table gives the complete list of combinations for alphabetic punching.

DIGITS	ZONES		
	12	11	0
1	A	J	UNUSED
2	B	K	S
3	C	L	T
4	D	M	U
5	E	N	V
6	F	O	W
7	G	P	X
8	H	Q	Y
9	I	R	Z

In addition to the above list for alphabetic punching, a system of symbols is provided for by utilizing the following combinations of punches.

12	11	0	1	2	3	4	5	6	7	8	9	SYMBOLS
						X				X		□
					X					X		@
X						X				X		#
X					X					X		.
	X					X				X		*
	X				X					X		$
		X				X				X		%
		X			X					X		,
X												&
	X											—
		X	X									/

This system of symbols (optional) was introduced by the Type 407 Accounting Machine.

Duplication

Common data can be duplicated from any card into the following card. This is particularly useful in punching repetitive information, that is, information which is common to several cards. This avoids all card handling when duplicating manually punched information, and permits repetition of any field from one card to the next by a single depression of the duplicate key.

Error correction during key punching is greatly facilitated by this duplication feature. When an error is made, the operator need not repunch the card manually. Without any card handling, the operator can duplicate into the next card all information which has been punched correctly, and must rekey only the field in error. Program control permits such duplication accurately and easily, field by field, without concern for column numbers.

Program Control

Program control is a fast, simple means of setting up the machine for automatic control heretofore accomplished by the use of skip bars, cut out bars or tabular inserts. It consists of punching control codes in an IBM card and inserting it in the machine on the program drum. The holes in the card are sensed by star wheels which transmit motion to their respective contacts and control circuits.

Under program control, the Type 24 Card Punch duplicates at the rate of 20 columns per second. Skipping

and card release proceed at the rate of 80 columns per second. After a card is punched in column 80, the next card is fed into position in one-fourth of a second.

The Type 26 Printing Card Punch operates at a slightly lower speed because of restrictions of the printing mechanism (17 columns per second).

The almost complete visibility of the cards in the card bed facilitates the design and punching of dual cards, and the identification of prepunched cards into which more data must be punched. Direct access to all parts of the card bed also permits easy manual insertion and removal of cards when necessary. For cards that have been put in registration and fed part way through either the punching or reading station, a mechanical release allows the easy removal of cards should it be desired or necessary at that time.

Cards feed from the top of the file. Cards placed in the magazine face forward, 9 edge down will feed through the machine face up and stack in the same order fed. Reversing is therefore not necessary to maintain the same sequence. It is not possible to reverse the order of cards with this style feed and stacker.

Optional features include the following items which are applicable to both the Type 24 Card Punch and Type 26 Printing Card Punch:

1. The alternate program device makes it possible to punch codes for two separate card designs in the same program card. It is operated from the keyboard by a special key.
2. The auxiliary duplicating unit utilizes a second card drum. This card usually carries common data to several but not all cards to be punched. This unit is also controlled by a special key on the keyboard.

Column and Field Indicator

The indicator, located at the base of the program drum holder, indicates to the operator the next column of a field to be punched. Spacing or back spacing is facilitated by reference to the indicator. For the most efficient use of this feature, cards should be designed with field headings at the bottom of the card.

Should the graduations on the indicator dial continue for the entire circumference, it would be found to contain 88 columns, that is, column 88 would be followed by column 1.

Keyboards

One of two basic classes of keyboards may be specified for either machine, but only one can be used on any one machine. For numerical punching only, the keyboard shown in Figure 1 is provided. When alphabetic information is to be punched, the combination keyboard in Figure 2 is used. Both keyboards may be found to contain the extra keys or switches for optional features. Both can be moved anywhere on the reading board but not removed from the machine without the services of a Customer Engineer.

Figure 1. Numerical Keyboard

These keyboards have the light touch, short depression, and small climb characteristic which makes them easy to operate. The "home" keys have been made more concave than the other keys to facilitate accurate touch operation.

In the combination keyboard, the usual fourth row of keys have been eliminated and 10 of the letter keys at the right serve the dual purpose of digit punching as well as letter punching. This permits numerical punching with the right hand in what is the normal "home" position for alphabetic punching and leaves the left hand free.

Advantages of the arrangement are made practical by automatically shifting these 10 two-purpose keys under program card control. As the operator progresses from an alphabetic field to a numerical field, or vice-versa, touch operation can be continued without interruptions.

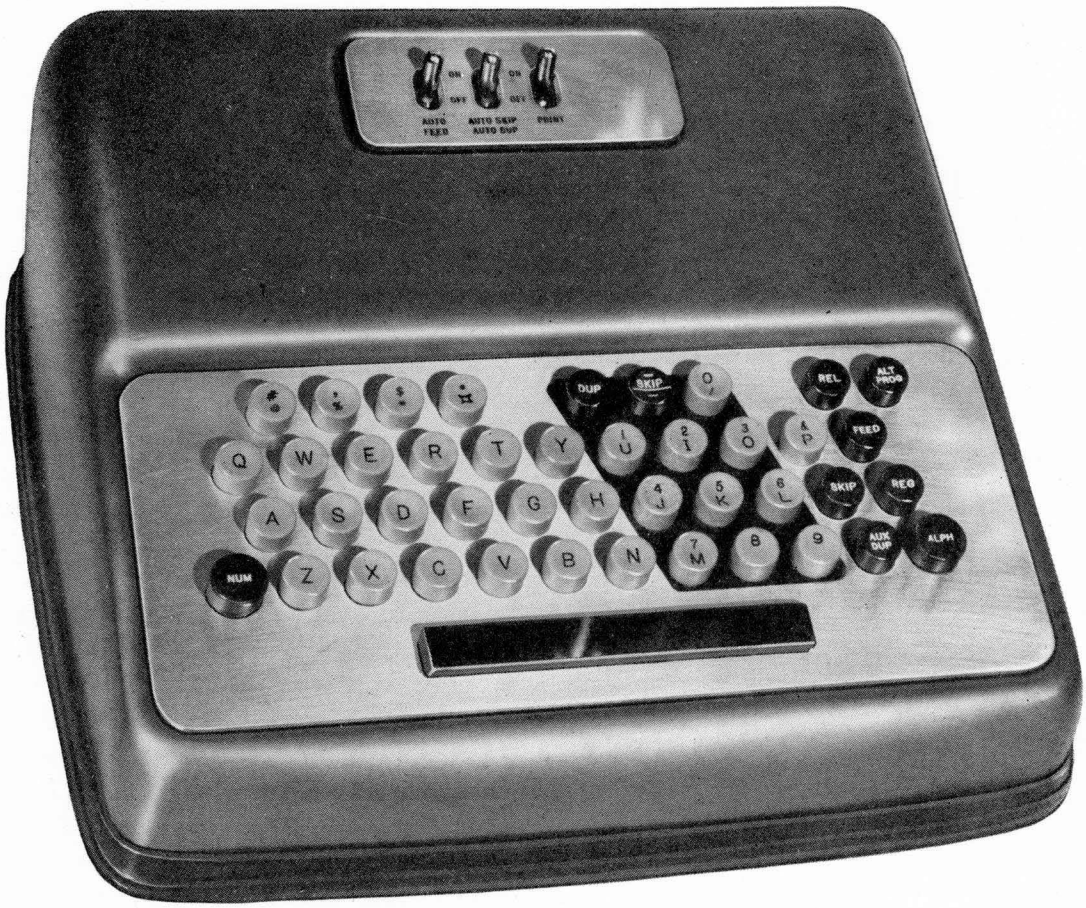


Figure 2. Combination Alphabetic and Numerical Keyboard

Current, Weight, Dimensions

TYPE 24-26 POWER REQUIREMENTS

115V A.C. 60 cycle	2.5A.
115V A.C. 50 cycle	3.2A.
230V A.C. 50-60 cycle	1.6A.

TYPE 24-26 WEIGHT AND DIMENSIONS

	TYPE 24 PUNCH	TYPE 26 PUNCH
Weight Unpacked	180 lb.	230 lb.
Weight Packed	310 lb.	360 lb.
Length	28 in.	28 in.
Width	31 in.	31 in.
Height	39 in.	39 in.
Heat Dissipation	24-26	220 B.T.U.

The Program Drum (Figure 3)

After an IBM card has been punched with a special code, it is placed on a cylinder called the program drum and held by a manually operated clamping strip. The drum is inserted in the machine on a shaft and held by a detent spring on the drum hub. A pin aligns the drum with the column indicator dial.

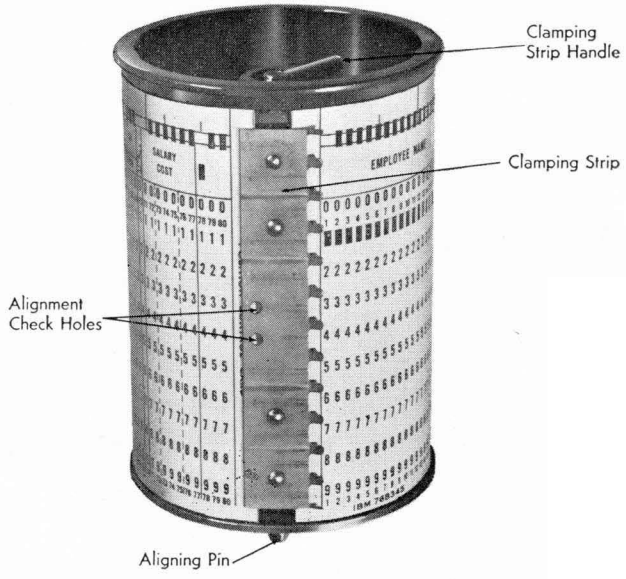


Figure 3. Program Drum

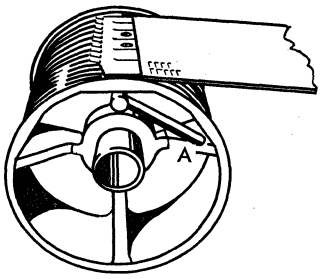


Figure 4. Insert Column 80 End

To place a program card on the drum, rotate the retaining strip handle as in Figure 4. Now insert the column 80 end of the card holding it toward the 9 edge. Check through the alignment holes to see that the card is snugly against the stop. Rotate the handle toward the center hub as in Figure 5. Curve the card completely about the drum and insert the column one end (Figure 6). Fingers are formed on the retaining strip to aid the insertion of the column one end.

Before the drum can be removed from the machine, the program control lever (Frontispiece) must be operated to the left. This raises the star wheels from the program card. As the program shaft rotates, it operates the program drum lock and two switches. The lock prevents damage when trying to remove the drum while the star wheels are lowered against the drum.

Program control lever switch 1 permits a card to be released at top speed when not programmed.

The second switch shifts the combinational keyboard to alphabetic when the star wheels are raised (not programmed). On machines with numerical keyboards, switch 2 closes to permit manual duplication from the duplicate key over blank columns in the master card.

Preparing the Program Card

Proper punching in a given column of the program card controls all automatic punching operations in the corresponding column of the card being punched.

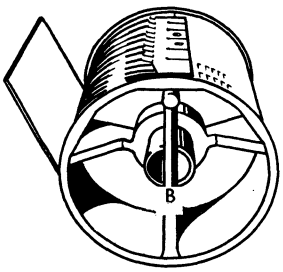


Figure 5. Column 80 End Locked

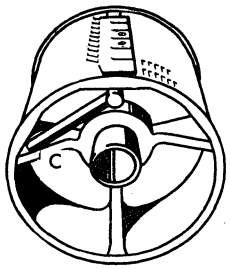


Figure 6. Column 1 End Secured

The particular punching required in that column of the program card depends upon the functions to be controlled. Each digit row in the program card serves a specific purpose in this respect as follows:

A 12 hole should be punched in the program card in every column except the first of every field to be punched, skipped, or duplicated. Several consecutive fields to be skipped or duplicated as one should be programmed as one. The 12 contact is used for a hold circuit throughout a field that was set up by the punch in its first column. When skipping, the 12 punch in the program card makes it possible to skip over all but the first column of that field at 12 milliseconds (ms.) per column. The 12 position is referred to as the "field definition."

An 11 hole serves to initiate an automatic (high bar) skip. An 11 punch in the first column of any field automatically starts a skip over that field which is continued by the 12 holes punched in the remaining columns of that field.

A zero hole starts automatic duplication. A zero punched in the first column of any field starts automatic duplication of that field which is continued by the 12 punches of the field definition over the rest of that field.

In all columns of all alphabetic fields to be manually punched or duplicated, 1's must also be punched in the program card. Under program card control the combination keyboard is normally in a numerical shift. However, in an alphabetic field, the 1's of the program card shift the two-purpose keys of the combined keyboard to punch letters (lower characters) instead of digits (upper characters on keytops). During auto-duplication of alphabetic information the 1 holes also cause automatic spacing over blank columns or prevent skipping when an X punch is duplicated.

When auto-duplicating in a numerical field, if a blank column is sensed, the machine will stop. It is then neces-

sary to depress the ALPH key over this column or punch 1's in the program card. Numerical information can be auto-duplicated whether programmed for alphabetic or numerical keyboard. The 1's are suggested to allow auto spacing in a numerical field where it is not desired to sense for blank columns.

When duplicating is being performed on machines equipped with the numerical keyboard, the 1 punch in the program card serves a similar purpose. Although it cannot control this keyboard alphabetically, the 1's in the program card permit auto-spacing over the blank columns of an auto-duplicate field but do not prevent X skipping after pin sensing a letter code with an 11 punch in it.

When duplicating without 1's in the program card, duplication into a blank column will lock up the machine. It is possible to clear this condition by three methods:

1. With the combination keyboard depression of the ALPH key will cause a space into the blank column.
2. Lift the star wheels and cause a space into the blank column.
3. Depress the back space key and drop out the duplicate relays.

The third method can be used to unlock the keyboard when it is electrically locked up.

Figure 7 gives an example of a program card. In columns 1 through 6 the 1's are omitted to blank column check, but the two fields 1 through 6 and 7 through 20 are handled as one auto-duplicated field. Field 21 through 40 is skipped and the 12's make it skip through column 40. Notice that column 61 has a 1 punch without a 12, 11 or a zero. The 1's may run from field to field and do not interfere with auto-duplicating or auto-skipping operations. Single column auto-duplication or auto-skipping requires only the single appropriate punch in the program card.

Preparing the Program Card (Type 26 Printing Card Punch)

In addition to all the identical operations of punches 12, 11, 0, and 1, (which are the same for both Types 24 and 26 machines), the Type 26 Printing Card Punch has a program control for printing and the suppression thereof.

The suppression of zeros to the left of the first significant digit is normal on this machine. With printing controls it is possible to modify this normal suppression of preceding zeros by punching a 2 hole in the program card in every column in which a zero to the left of the first significant digit should be interpreted. For example, a 2 hole punched in the tens columns of an amount field will insure interpretation as 05 instead of the lone 5, provided the zero is also punched in the card. The program unit does not supply any codes to the printing mechanism but controls the impulses to the print suppress magnet and the print relay. Information must be punched in order to be interpreted and printed.

Finally, with the Type 26 Printing Card Punch it may be desirable in some cases to suppress the printing of an entire field. This can be accomplished by punching a 3 hole in the program card for every column of that field.

Alternate Program Device

Machines can be equipped to use the lower half of the same program card for an entirely different "alternate" program which can be substituted for the

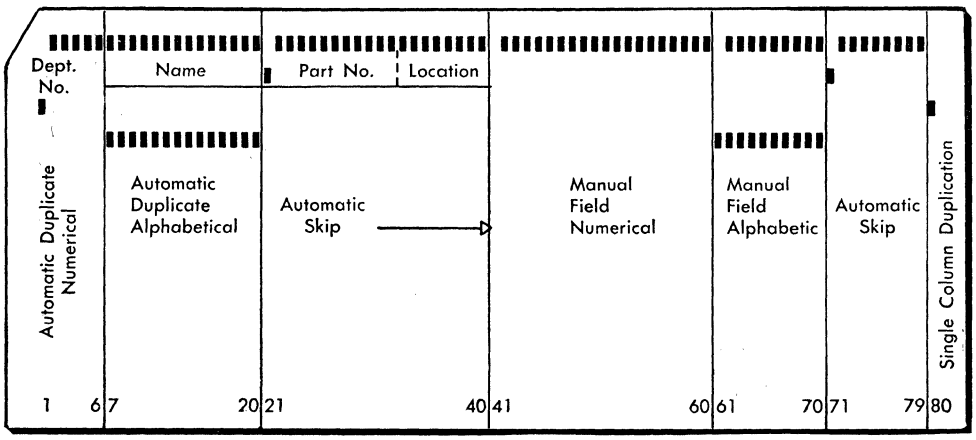


Figure 7. Program card

normal program by a single keystroke at any time in a given card cycle. The alternate program will then control the punching for the remainder of that card, but control will revert to the normal (upper) program for the following cards. In other words, the alternate program feature drops out on the next card feed cycle and requires another operation of the ALT PROG key to become operative again. This permits two different card arrangements in succession in the same operation, without programming conflicts.

The digit row assignments for the alternate program parallel those of the normal (upper) program and are summarized below:

NORMAL PROGRAM	FUNCTION	ALTERNATE PROGRAM
12	Field Definition	4
11	Start Auto-Skip	5
0	Start Auto-Duplication	6
1	Alphabetic Control	7
2	Print Preceding Zeros	8
3	Suppress Printing	9
blank	Start Manual Field	blank

Switches

The main line switch mounted in the stacker bed serves the second function of a stacker stop. As the stacker reaches capacity, the stacker plate turns the machine off. This is a locking switch and must be thrown ON again to continue operation once the cards are removed from the stacker. A short warm-up period is required to allow the tube filaments to reach their operating temperature. No thermal delay relay is used although circuit design provides timings which eliminate errors when the keyboard is operated before the machine has warmed up.

The control switches have been placed on the keyboard within easy reach of the operator.

Auto-Feed Switch

Turned ON, this switch causes a new card to be fed and another registered each time a detail card is punched in or skipped to column 80. Turned OFF, this switch permits hand feeding through the use of the REG key. The feed key must be operated for each new card from the hopper with this switch OFF.

Auto-Skip, Auto-Dup Switch

When turned OFF, this switch cripples automatic duplication by program control as well as auto-skipping from this same source. Fields in which these operations were programmed then become manual fields. Turned ON, the above features function normally through this switch.

Print Switch

The third switch appears only on the Type 26 Printing Card Punch. Turned OFF, the print switch eliminates all printing. Turned ON, automatic suppression of zeros to the left of the first significant digit is normal and can be controlled by the program card. Refer to the section *Preparing the Program Card—Type 26* for print control information.

Keys

As all the normal functions of the machine are workable from the keyboard, all but the NUM (numerical), ALPH (alphabetic) and DUP (duplicate) keys are interlocked and may be depressed only one at a time.

The keys are electrically restored after each operation. All but those mentioned above are held restored for automatic functions such as card feeding, auto-duplicating, or skipping.

ALPH (alphabetic shift)

When the alphabetic key is held depressed, alphabetic punching can be accomplished in a normally numerical field. This key also permits auto-spacing over blank columns of a numerical field when duplicating.

NUM (numerical shift)

Depressing the numerical key shifts the 10 two-purpose keys so that numerical punching may be accomplished in a normally alphabetic field. Top figures on the key tops are under numerical control.

DUP (duplicate)

If this key is depressed when programmed for a manual field, it will cause the entire field to be duplicated under control of the field definition 12's at 50 ms. per column.

When the program star wheels are raised, duplication takes place at the rate of 100 ms. per column so long as the key is held down. At this speed the operator can maintain close control when duplicating to an error column.

—SKIP (punch an X, print a dash, and skip)

When the —SKIP key is operated in a programmed numerical manual field, an X will be punched and a skip initiated. The skip will follow the programmed field definition.

When depressed in a programmed alphabetic manual field, only an X punch will be accomplished.

SKIP

This key will cause a skip in either an alphabetic or numerical field without an X being punched when pro-

grammed. Field control is the same for the X skip key if programmed.

When the star wheels are raised (not programmed) and the skip key is operated, only a single column space will take place.

REL (release key)

When programmed, the release key will cause the card to skip out over all fields except auto-duplication which it will pick up. Since data is carried from one card to the following, information not yet duplicated at the column of release will be retained through program control.

With the star wheels raised, the card will release beyond column 80.

The REL key is not mechanically interlocked with the other keys, therefore, it can be depressed any time the keyboard is not held restored by auto-duplication or auto-skipping.

FEED

Normally used in conjunction with the auto-feed switch, two depressions of the feed key are required to get the first card of a group into punching position. With the auto-feed switch ON, feeding is automatic following the approach of column 81. With the auto-feed switch OFF, the feed key is required to bring each new card to the card bed and stack the last master card read.

REG (register key)

In the absence of the familiar card rack, card progress and registration are maintained through the use of two serrated feed rolls under control of the escapement mechanism.

The REG key causes a card feed cycle but blocks the feed knives. In this manner, no new card is fed but registration and ejection takes place. This key is not operated with the auto-feed switch ON because each new card feed registers the cards automatically.

The REG key finds its main use in hand feeding of cards to cause these cards to be registered either for reading or punching.

SPACE BAR

The space bar provides single column space operations without punching. When the auto-feed switch is ON, depressing the space bar in column 80, will cause the card released from the reading station to be ejected and stacked and a new card to be fed into the punching station.

The space bar is also used for multiple punching single columns. By holding the space bar down, one or several other keys can be operated. All other keys punch as indicated on their keytops.

BACK SPACE KEY

In addition to causing the cards in the punching station, the reading station and the program card to be back spaced column for column until column one is reached, this key operates the back space switch.

The back space switch breaks all the circuits to the tube grids. When programmed, the sensing star wheels will make their respective contacts as each field is encountered. The switch prevents the pickup of these controls until the desired column is reached.

The back space switch also serves to drop out the duplicate circuits when duplicating too far. Without program 1's to cause auto-spacing over blank columns, a blank column sensed will cause the machine to lock up. Since the keyboard is automatically held restored on auto-duplication, a separate means, outside the keyboard, is provided to relieve the condition through the use of the back space key.

TYPE 26 PRINTING CARD PUNCH

Standard Symbols

A program 2 punch is necessary to print two of the three standard symbols appearing on the combination keyboard, the dash and ampersand, when they precede the first significant digit of a field. These standard symbols fall in the same operational category as the zero and must be forced to print if they appear in a field before the first significant digit.

The diagonal mark (/), it must be remembered, will punch a 0-1 combination which causes a zero to print on older IBM machines.

A hole must be punched in order to be interpreted but a punched hole can be blocked from printing by a program 3 punch in the corresponding column of the program card.

Optional Feature Keys

SPECIAL CHARACTERS

The (four extra) special character keys punch and print the top symbol for numerical and punching the lower symbol for alphabetic punching. No special programming is needed since the code punched for each of these four keys contains significant digits.

ALT PROG KEY (alternate program)

A single depression of the ALT PROG key will cause the machine to follow the bottom half of the program card for the balance of that card. After each card feed cycle, it will be necessary to use this key to utilize the alternate program feature since control reverts back to the standard control on each card feed cycle.

AUX DUP KEY (auxiliary duplication)

When the AUX DUP key is operated in a manual program field, information punched in the auxiliary program drum is duplicated into the detail card under field definition control. When not programmed, this feature operates column for column each time the key is held down.

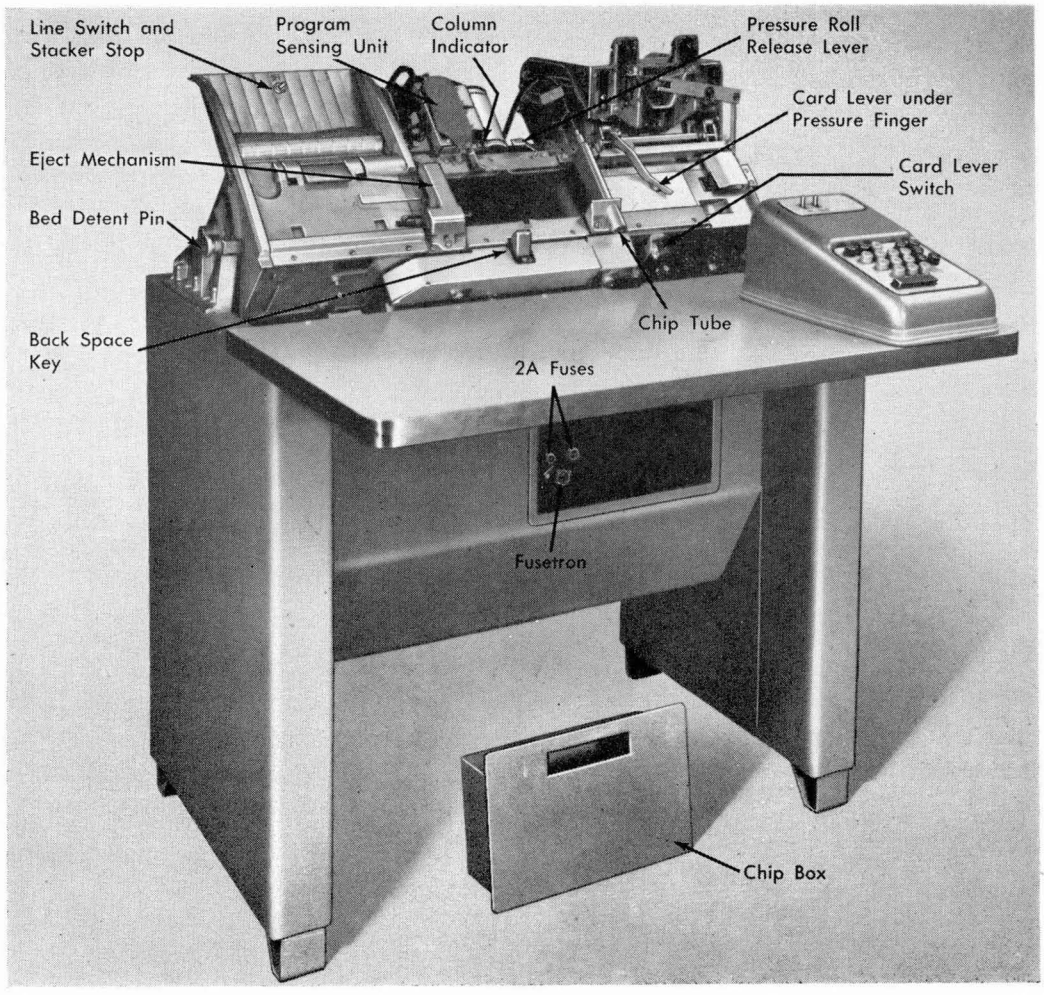


Figure 8. Type 24 Card Punch—Front View

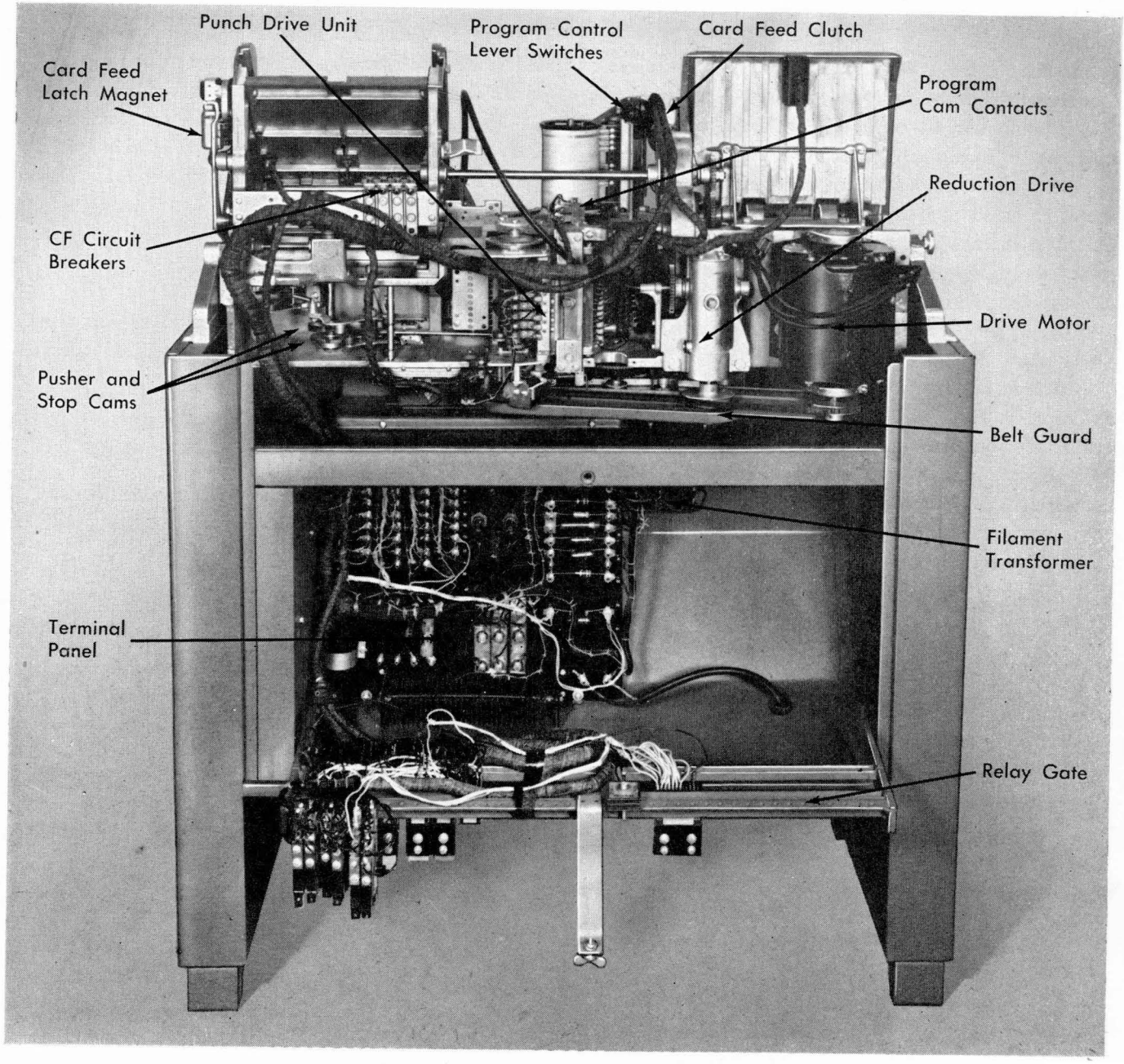


Figure 9. Type 24 Card Punch—Rear View

CARD FEEDING in the Types 24-26 is quite different from other older types of IBM punching machines. Under normal operating conditions two cards are in the punch station at all times. By registering the second card shortly after the first card is punched in column 80, three-fourths of the feeding time is saved. Figure 10 shows the card path from the feed hopper to stacker. On the first card feed cycle a card leaves the hopper, passes through stage 1 and ends at stage 2. On the earliest portion of the second card feed cycle, a card is aligned at position 3 and pushed to 4 preparatory to punching.

Attention is called to the column at which cards are registered in Figure 10. The program drum and master cards are standing in column one while the detail card is in column zero. It can be seen why lower left-hand corner cut cards should not be used. While cards are advancing through the punching and reading stations, they are held and moved by a large serrated roll underneath the card and a smaller pressure roll on top of the card. These two rolls grip the card at its bottom edge. If lower left corner cut cards were used, these feed rolls would be unable to grip the card, especially in the punching station where the card is registered in column zero.

DRIVE UNIT

Two V belt drive pulleys and a reduction gear supply power to all the machine. The motor drives the following continuously:

Punch clutch driving sleeve
Chip ejector flexible shaft and blade
Card feed clutch rachet
Read and eject continuously running feed rolls
Friction drive

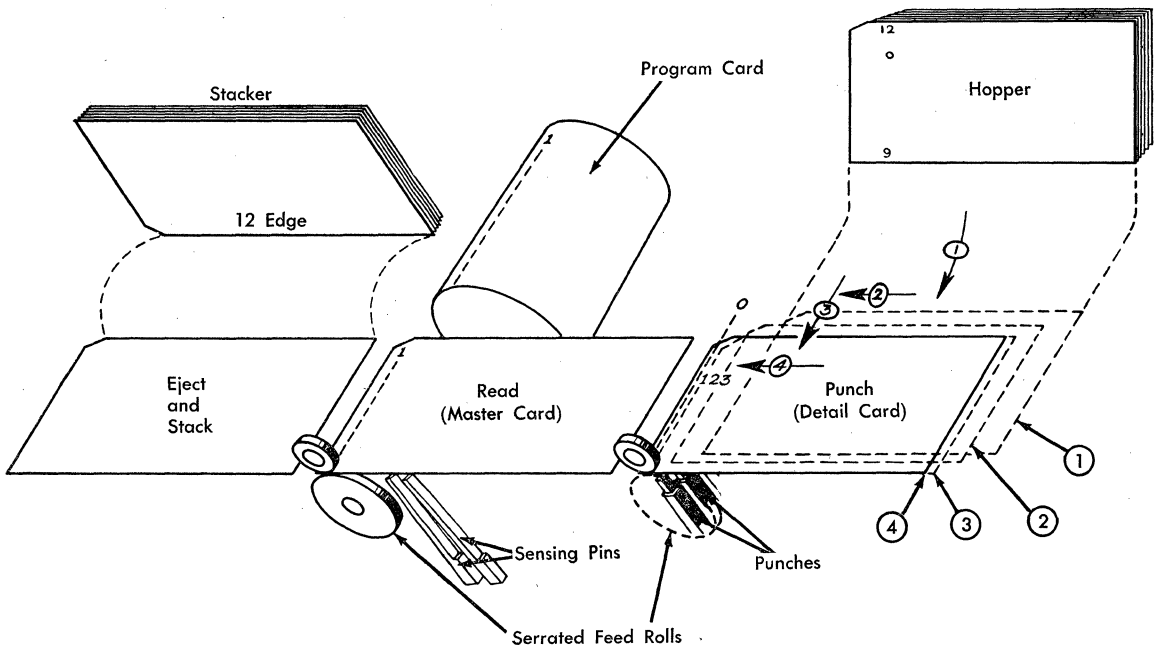


Figure 10. Card Path Through the Machine

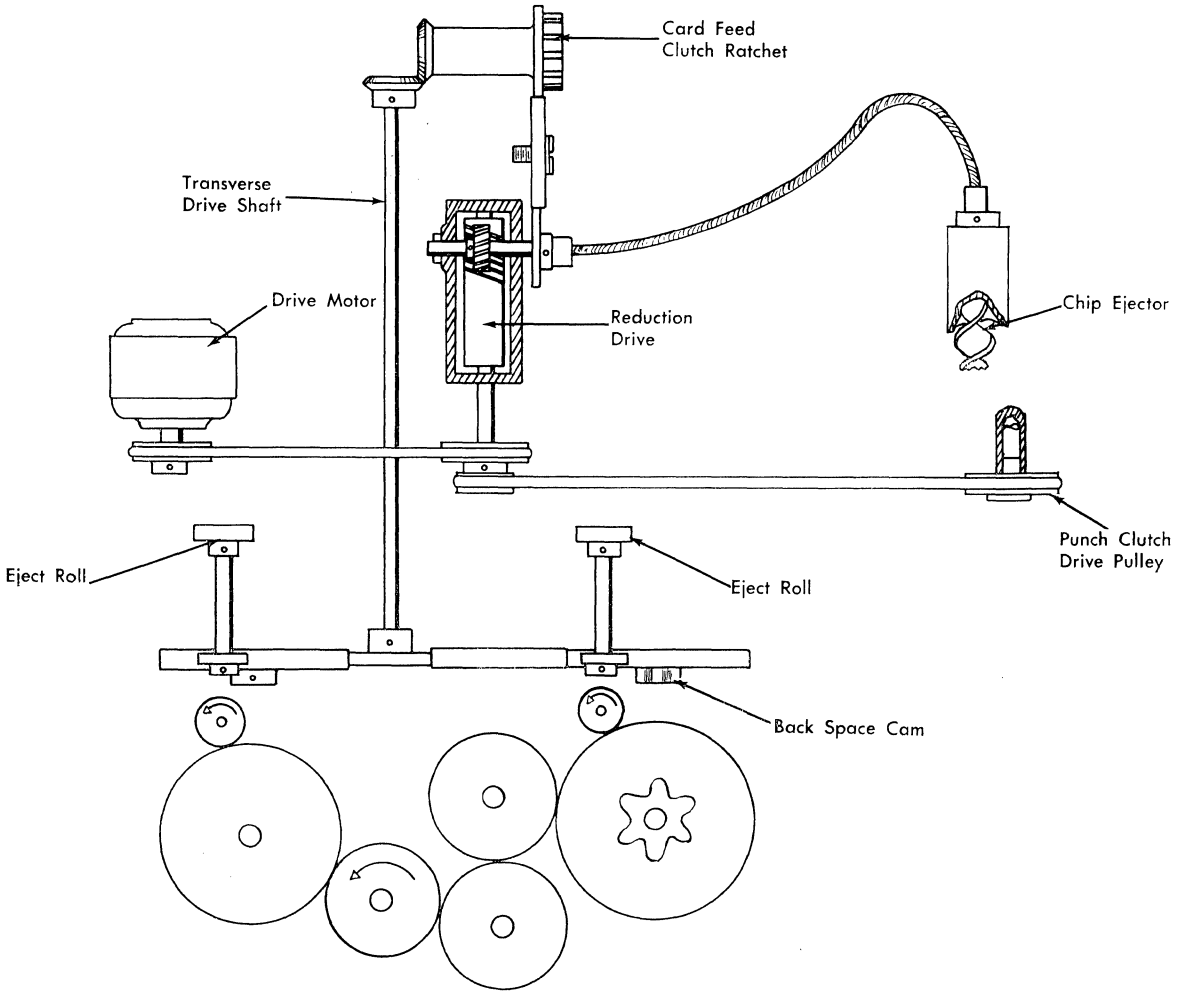


Figure 11. Continuous Drive

Friction Drive to Escapement

In Figure 11 notice the transverse drive shaft. This shaft brings motion from the rear of the machine to the gear train along the front of the punch bed.

The transverse drive puts a friction load on the escapement gear train (Figure 12) through the friction drive. This places the feed rolls under control of the escapement armature. Hence, energizing the escape magnet will cause the space gears to operate the read feed roll, punch feed roll and the program drum in synchronism.

By placing cam contacts in such a manner as to be operated by a cam on the program drum shaft, control of feeding is similar to that of a first column contact and a last column contact.

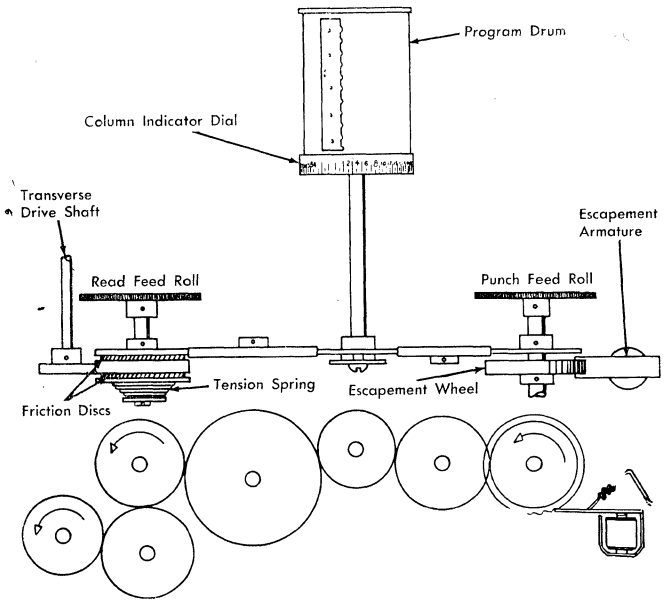


Figure 12. Spacing under Control of the Escapement Armature

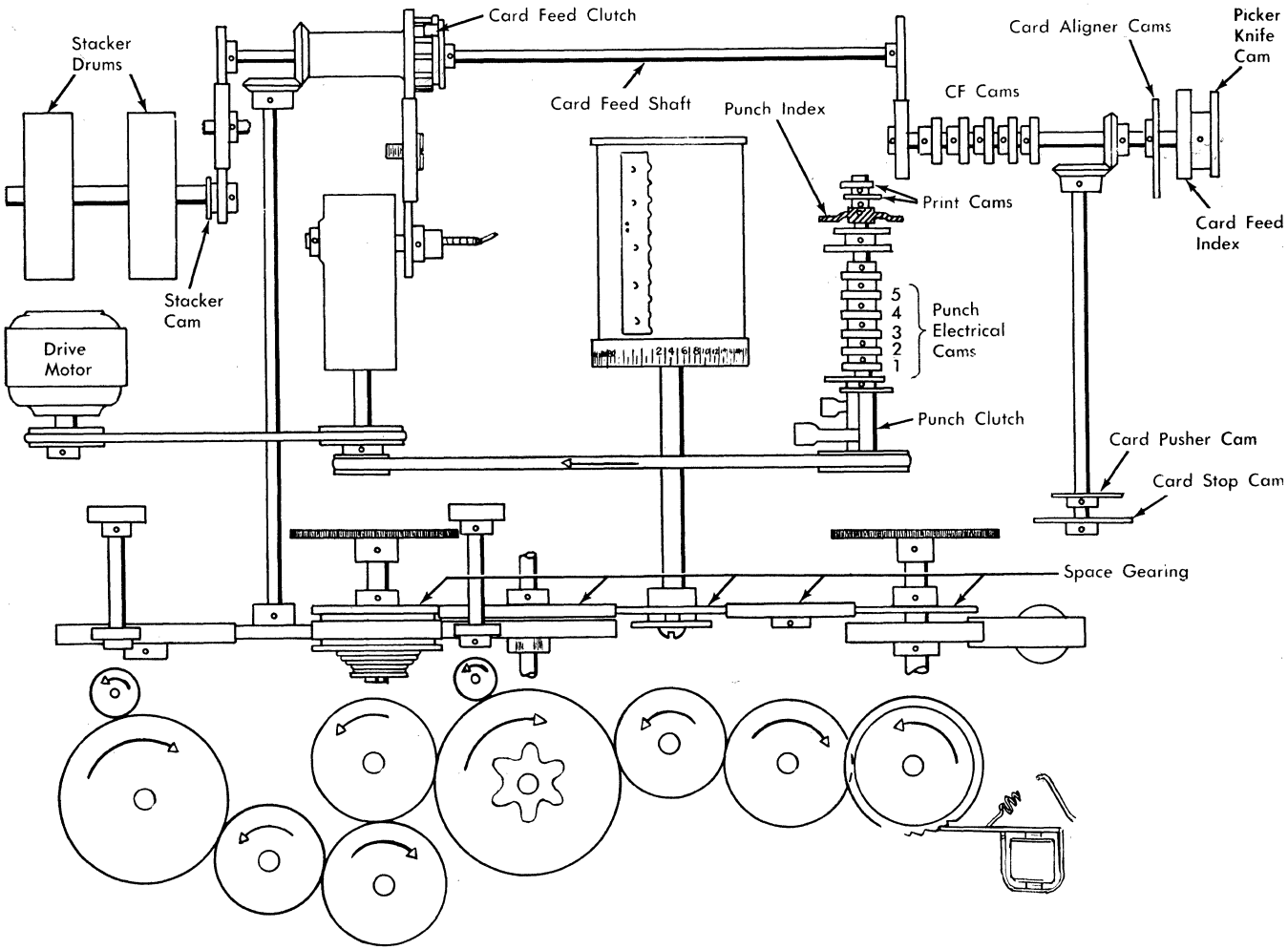


Figure 13. Complete Drive Schematic

In Figure 13 all the feed members have been combined with the card feed drive assembly. An impulse to the card feed clutch will cause not only the card feed to operate but the stacker unit as well. Any time the CF clutch magnet is energized, whether the feed key is used for a new card or a register key for a hand-fed card, the stacker, card feed circuit breakers, card aligner, card pusher, and card eject cams operate.

CARD FEED UNIT

Card Feed Clutch (Figure 14)

The card feed clutch is a standard dog and ratchet type with a detent cam and latch to maintain clearance between the clutch dog and the ratchet.

Attention is called to the type of armature spring used on the card feed magnet armature. The flat spring around the yoke can be shaped to give the proper

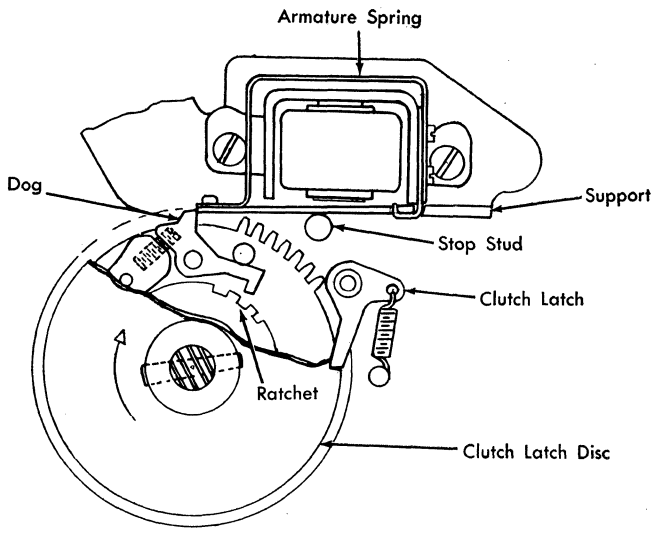


Figure 14. Card Feed Clutch and Magnet

operating tensions. Each time the card feed clutch magnet is impulsed, the CF clutch will make one revolution and latch up. Momentum of the drive mechanism compresses the dog spring and permits the detent latch to drop into the notch in the clutch latch disc.

The card feed clutch controls the operation of the stacker, feed knives, cams, aligner fingers, pusher arm, pressure roll opening device and eject mechanism.

The card feed clutch magnet can be energized through the feed key, the REG key or program cam contact 2 (when the auto-feed switch is ON).

The card feed ratchet is continuously driven through an idler gear from the reduction housing and drive motor. The ratchet assembly rides free on the card feed shaft.

Hopper

About 500 cards can be placed in the hopper face forward, 9 edge down and are held forward by the spring driven pusher plate. Two magazine springs keep the cards from falling through the knife and block type throat.

Since the cards are registered at the punching station, the hopper has sufficient end play to permit easy insertion of new cards. The pusher plate latches in the rear position to aid in card manipulation.

Feed Knives

With the auto-feed switch ON, two card feed cycles are needed to carry the first card to the punching position. Thereafter single card feed cycles position each following card in one-fourth second and a new card is fed into the bed. On the first feed cycle, the two feed knives grip the 12 edge of the card and slide it through the throat to the first of two sets of feed rolls. Card guide plates direct the card through its curved path to the punch bed. As the first card leaves the second set of feed rolls, card aligner fingers push the card under the card rail and onto the bed. The rear edge remains under the rail (Figure 15). The card lever pressure finger acts as a card guide and holds the cards against the punch bed and the punch card lever.

Card Feed Latch Magnet

When cards are hand fed, it is desirable to advance a card to the read or punch feed rolls without drawing a card from the hopper. Figure 16 shows that the card feed cam follower arm is spring operated and cam restored. On a register operation it is desirable that everything on the card feed and stacker unit operate except the feed knives. A hook on the card feed latch magnet armature intercepts the CF cam follower arm and prevents it from moving the feed knives.

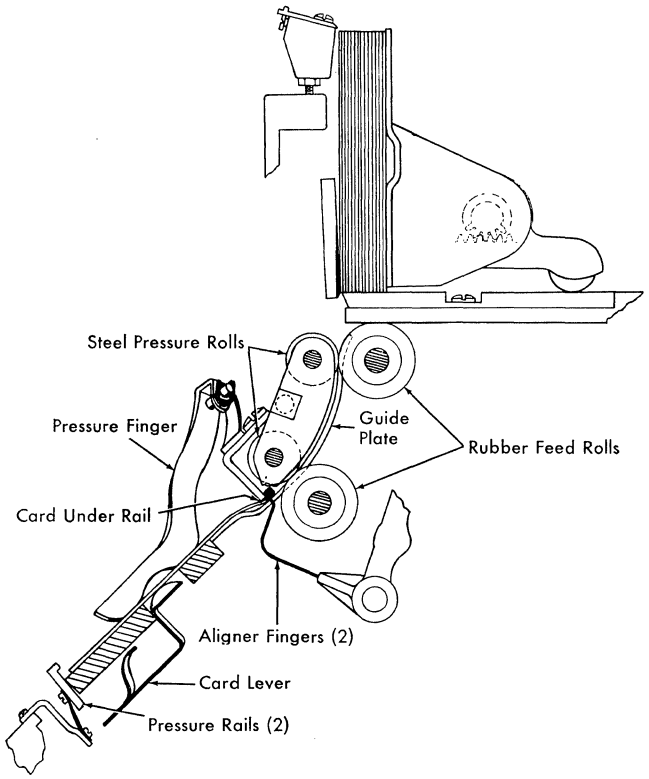


Figure 15. Card Feeding

Card Feed Index

The card feed index is mounted on the right end of the CFCB shaft outside the right side frame of the card feed unit. It is stamped on the side of the card feed roll drive gear. This index revolves at 60 RPM when the CF clutch magnet is energized. The card feed clutch latches up at zero on this index. The CF index is used to time in the card pusher cam assembly, the CF circuit breakers, and the card feed unit itself.

Card Alignment

On the first portion of the second card feed cycle the card aligner fingers (Figure 17) are cammed forward and move the first card against the front guide pressure rails and out from under the card retaining rail ready for registration. The forward movement is about one-fourth inch after which the aligner fingers are retracted to clear the path of the next card. When in the extreme forward position, the aligner fingers should extend evenly about .055″ beyond the card retaining rail.

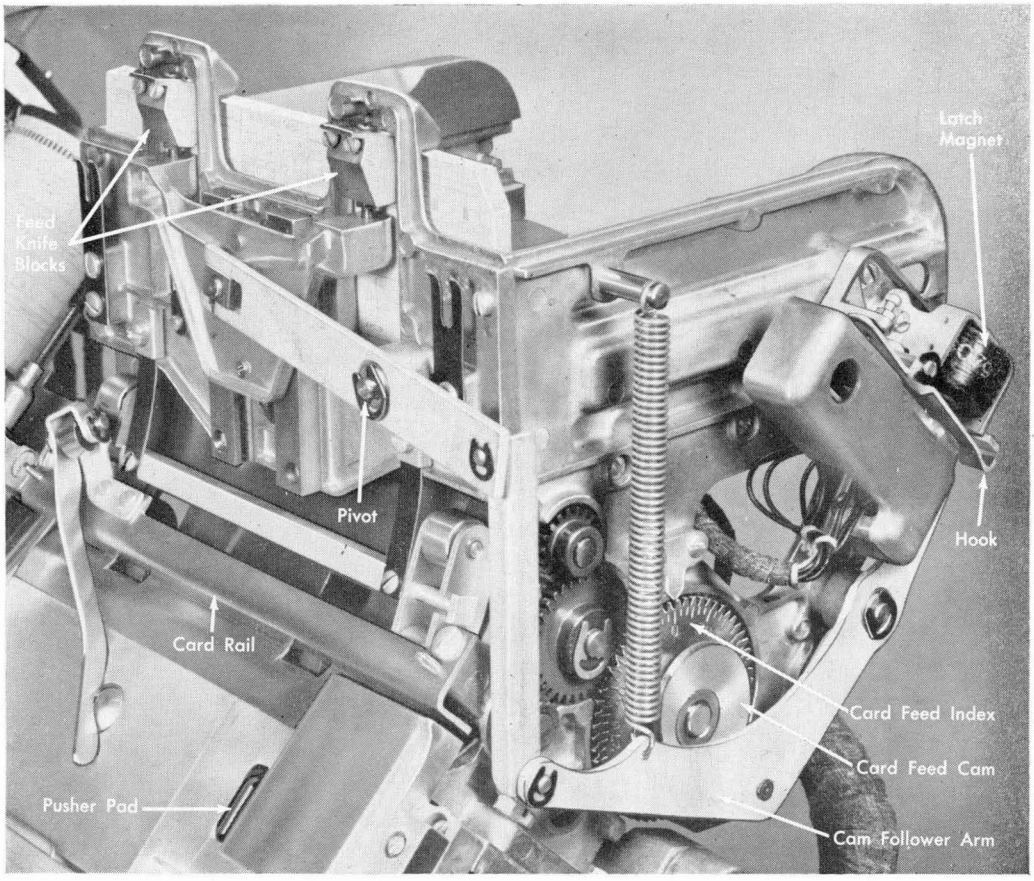


Figure 16. Card Feed Assembly

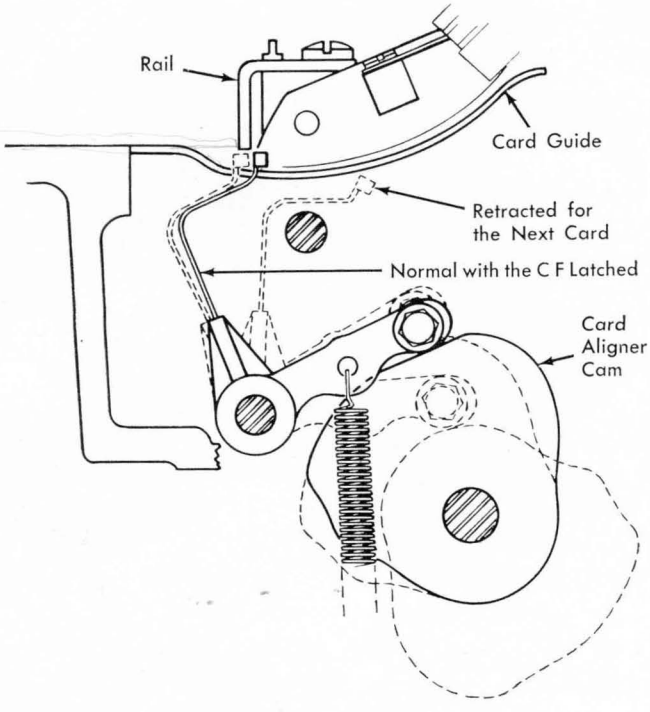


Figure 17. Aligner Fingers

Registration—Punching Station

As the first card in the punch bed is aligned, the card pusher arm positions it between the punch serrated lower feed roll and the punch pressure roll which is to take the place of a card rack. Registration occurs as follows:

After the aligner fingers position the card fully in the bed, the card pusher arm moves to the left engaging the card at the 80th column end. As the arm and card reach the limit of travel, the card pusher pad rides against the card from the bottom and squeezes the card to the pusher arm (Figure 18). The pusher arm travel is limited by its stop screw which is also the registration adjusting screw. As a new card arrives in the bed, the pusher arm is retracted to clear the card. Notice also that the pusher arm is spring operated in both directions to prevent injury to the operator's fingers.

In Figure 19, the card is being registered between the two feed rolls just inside the front rail. These rolls will close before the pusher arm is retracted.

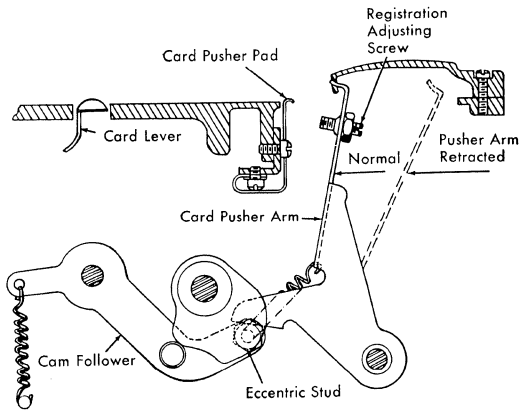


Figure 18. Card Pusher Arm

Both the read and punch pressure rolls operate from the same cam linkage when the card feed operates. The release lever located back of the punch bed and to the right of the program control lever opens both rolls (Figure 20).

Registration and Eject—Reading Station (Figure 21)

At the reading station the eject release pin, driven by the card stop cam, operates the registration and eject mechanism and opens and closes the pressure feed roll. This assembly is located directly over the sensing pin unit. The throat plate which forms the bottom of the eject mechanism is also the up-stop for cards at the reading station when the sensing pins rise.

As the release pin is raised, it operates the registration and eject lever. This lever performs three functions simultaneously: it raises the pressure roll; it lowers the read and eject pressure rolls against the continuously running feed rolls; and through an idler lever it permits a spring to rock the card register shaft causing the card stop plate to drop into the path of the card. These functions remove the last master card, stop and register the new master card all in one operation. The release pin is either operated during a card feed cycle or by the release lever. Figure 22 presents a side view of the card stop plate in operation. The stop plate block and shaft are spring operated because the card being ejected interferes with its dropping and it rides the card. It will snap down past the end of the ejected card to block the new master card. This is one of the reasons for the bevel to the bottom edge of the card stop plate.

Stackers

On the card feed cycle when the eject mechanism operates to lower the pressure roll against the stacker

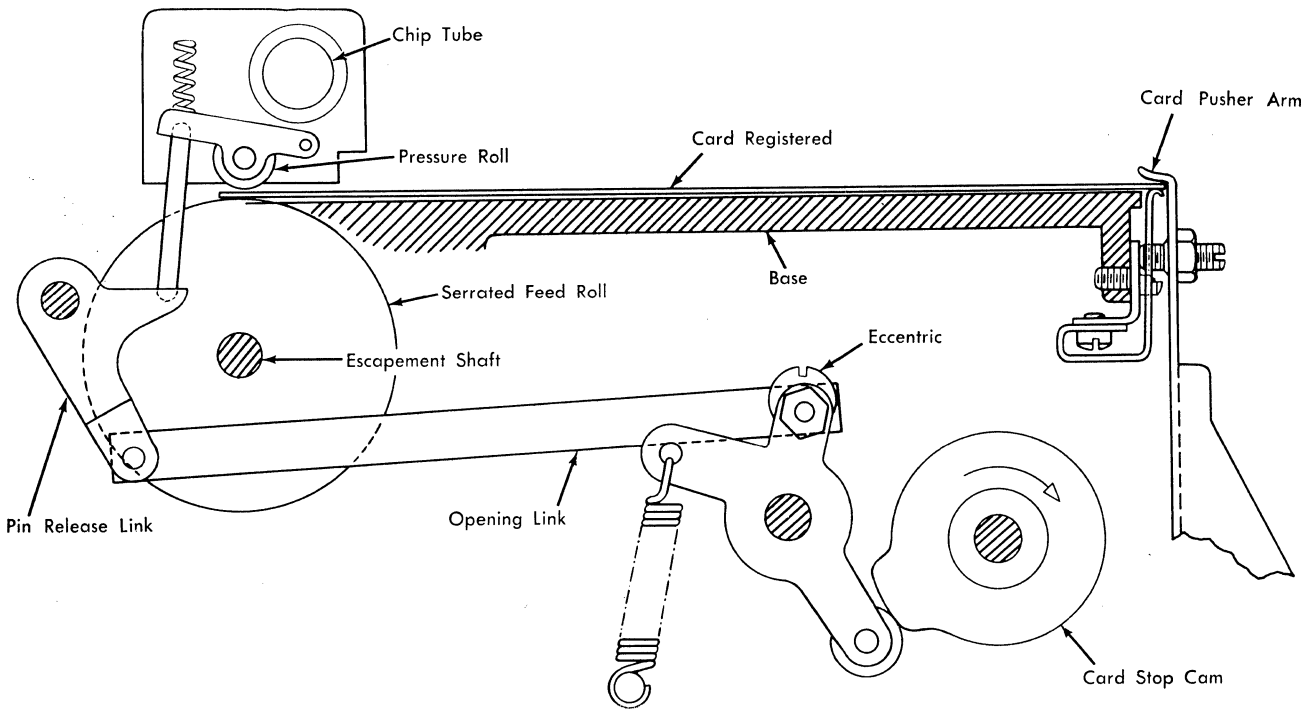


Figure 19. Registration—Punch Station

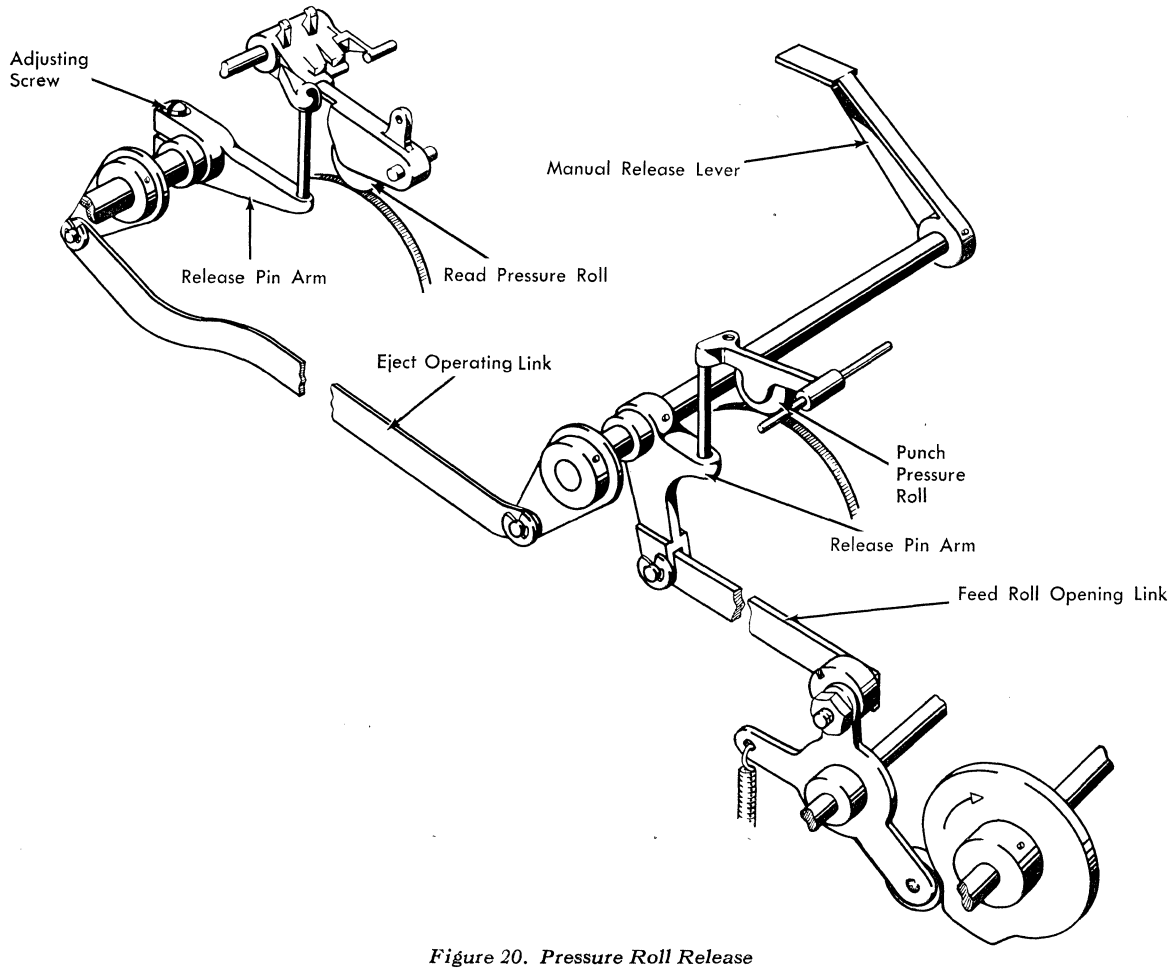


Figure 20. Pressure Roll Release

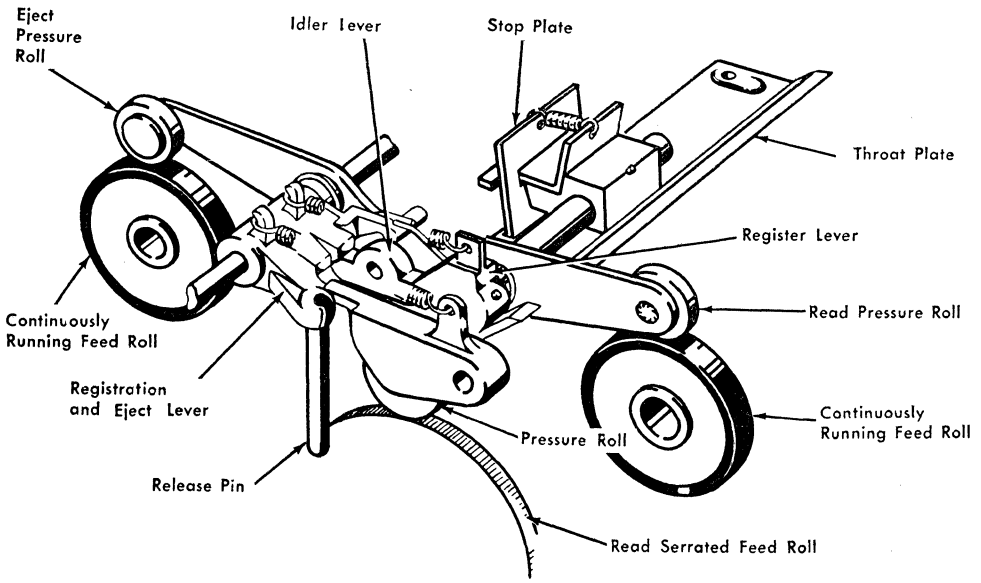


Figure 21. Registration and Eject Mechanism—Read Station

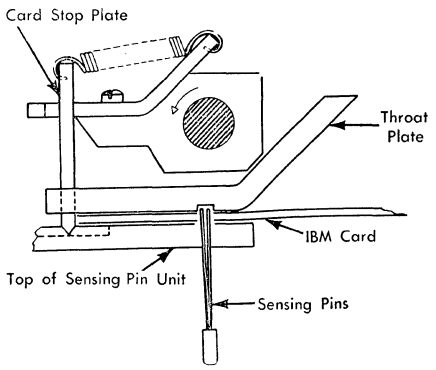


Figure 22. Registration—Read Station

continuously running feed roll, the card released by the read feed serrated roll is driven to the end of the card bed. As the card comes to rest against the end of the bed, the pressure roll is raised and two stacker pushers move the card toward the stacker drum fingers.

The stacker drum is in general the gripper finger type common to many of our machines. The gripper fingers are cammed open at the receiving points and again when the card reaches the stacker bed.

The traveling card guide (Figure 23) serves to hold the card to the bed and guide it to the open gripper fingers. The traveling guide pivots on the cam follower shaft and is operated by the card guide operating arm and link whose springs cause it to follow the stud on an arm pinned to the cam follower shaft. In Figure 23 the card guide operating arm contains the stud mentioned above.

After the card to be stacked is positioned under the gripper fingers, the traveling card guide rolls out of the card path allowing the card to pass enroute to the stacker bed.

An extra spring stud is provided in each stacker drum assembly so that identical drums may be used on either side.

Steel bumpers mounted in rubber are provided to arrest the traveling card guide in both directions and and to reduce noise.

ESCAPEMENT

THE DETAIL card is registered at the zero column, the master card is mechanically stopped at column one, and the program drum is stopped in column one because of its number 1 cam contact timing. Once this condition is established, the escape mechanism takes over control and all three move in unison through the same drive and escapement. A review of Figure 12 will show that the transverse drive gear through an idler gear (to reverse direction) imparts continuous drive to the friction drive.

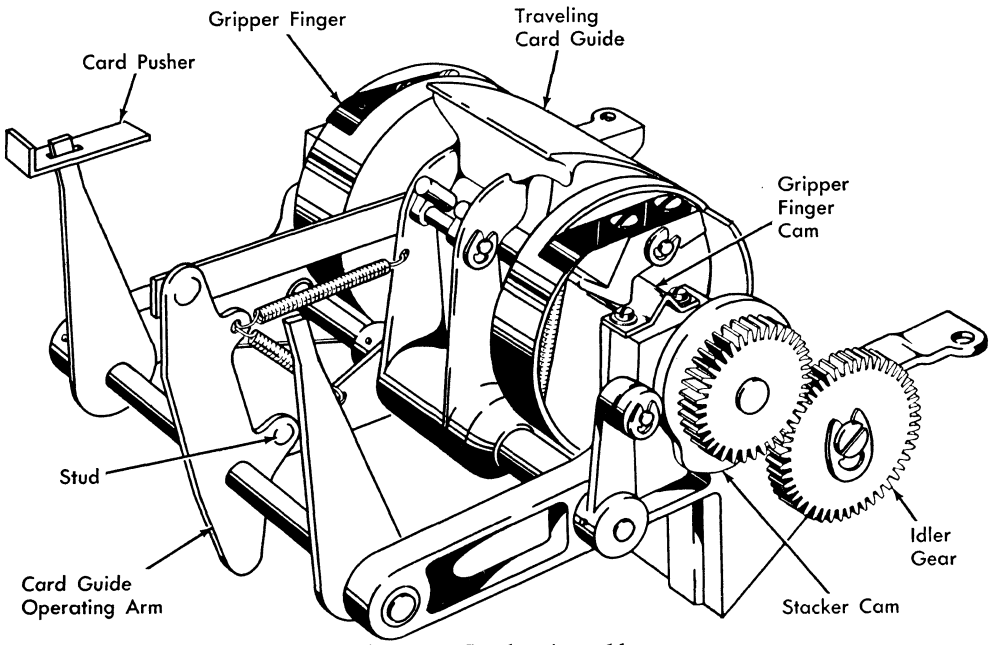


Figure 23. Stacker Assembly

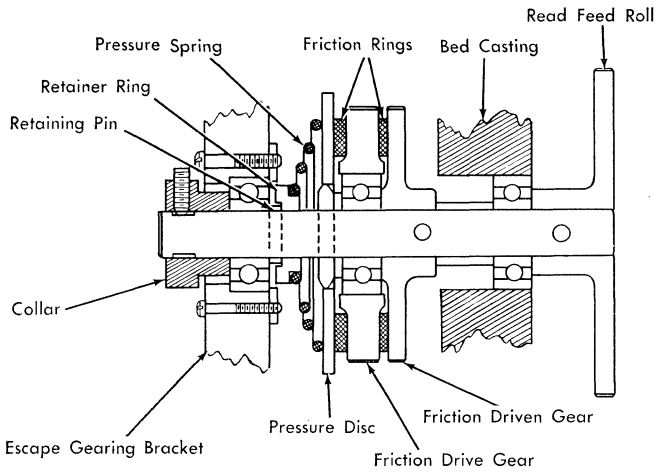


Figure 24. Friction Drive Assembly

Friction Drive (Figure 24)

The friction drive is continuously loaded due to the two friction rings pressed against either side of the constantly running friction drive gear. The entire assembly is compressed by the coil pressure disc spring against the space gear which is pinned to the drive shaft. The double pointed drive pin causes the friction disc to travel with the shaft and the spring assembly is held together by the pressure ring retaining pin. When the escape gearing bracket is removed, the friction drive remains together. The drive is built to operate with a torque of 5 to 7 inch pounds, but will operate satisfactorily down to 2 inch pounds.

Before attempting to remove the two serrated feed rolls which receive their motion from the friction drive, see the *Removal and Adjustment* section of this manual for the recommended procedures.

Escape Magnet Assembly (Figure 25)

When a key is depressed, an interposer magnet energizes, trips the interposer bail contact, and energizes the escape magnet. The escape magnet armature pulls out of a tooth in the escape wheel allowing it to rotate through force from the friction drive. At the end of the escapement armature travel, the armature pin closes the escapement contact and picks up the circuit to release the escape magnet. The time interval is short enough to drop the escape armature back in approximately the center of the next tooth of the escape wheel. Each tooth on the escape wheel causes the escapement gear train and feed rolls to advance one card column. To skip, it is necessary to hold the escape magnet energized thus allowing the escape wheel to rotate freely at its maximum speed of 12 ms. per column over the desired number of columns. This method is also used to skip between cards.

The escape magnet contact energizes the punch clutch magnet, therefore, the escapement always occurs before punching.

As the armature operates its pin near the limit of travel, the operating pin must be free in the armature. The auxiliary armature spring has a split end which holds the operating pin and this spring is tensioned against the stop stud.

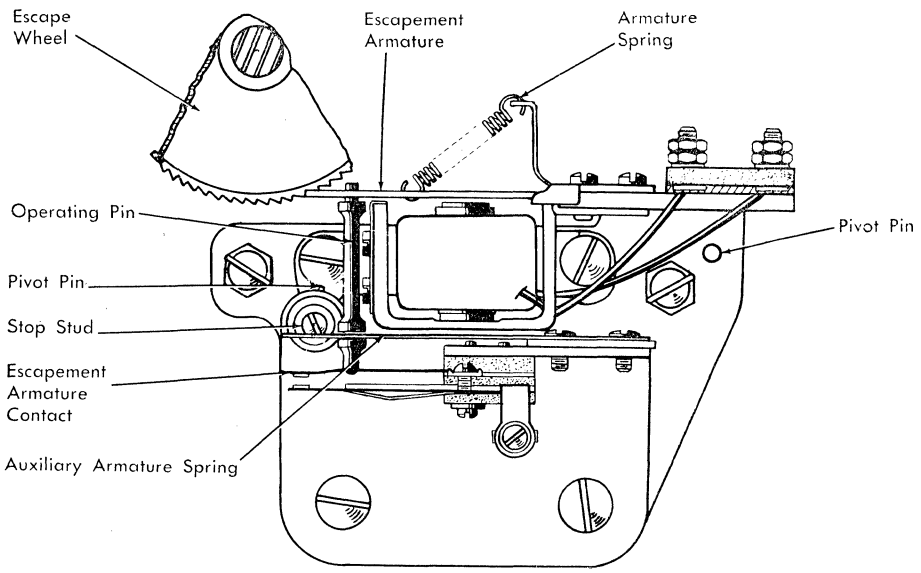


Figure 25. Escapement Magnet Assembly

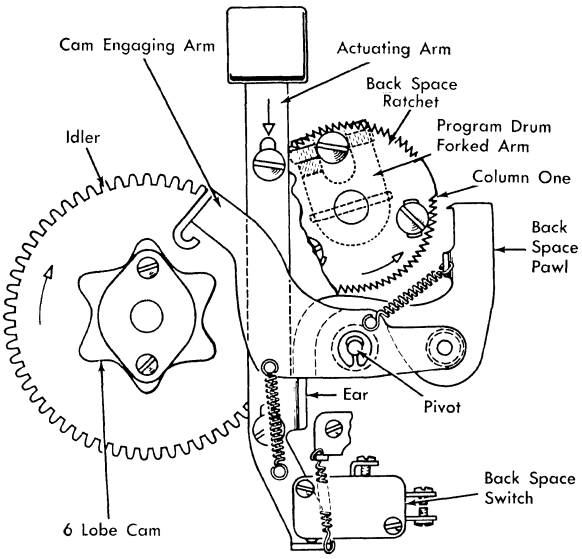


Figure 26. Back Space Mechanism

Back Spacer (Figure 26)

To advance the card column for column, electrical impulses interrupted the motion of the escape wheel. To back space the card in the punch bed, it is necessary to cause the escapement gear train to reverse its rotation against the friction drive and permit one tooth of the escape wheel at a time to back space past the escape armature without energizing the escape magnet.

The back space cam is mounted on the side of the fiber back space gear. This gear assembly rides the idler gear shaft and is driven continuously from the driving member of the friction drive.

In Figure 26 as the back space actuating arm is depressed, an ear on the arm permits the cam engaging arm to drop into a low dwell in the back spacing cam. The cam engaging arm revolves about its pivot and the back space pawl pivots on its stud in the engaging arm, allowing the back space pawl to engage the back space ratchet. As the cam engaging arm rides to the high point of a lobe, it pulls on the back space pawl and moves the escapement gear train backward one column. If the key is held depressed, this operation will continue until column one is reached where the back space pawl reaches a blank section on the back space ratchet.

The ratchet is mounted with three screws through elongated holes which provide adjustment for column one and single column operation. The back space switch opens the control circuits during this operation.

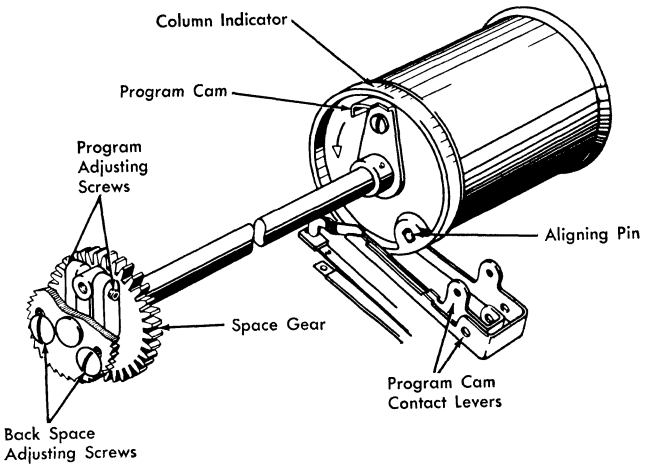


Figure 27. Program Drum Assembly

NOTE: If the detail card has been spaced past column 78, the detail card not yet registered must be removed to permit back spacing because the cards are no longer overlapped and will jam.

PROGRAM DRUM

BEHIND the back space ratchet in Figure 27 is the adjusting arm for the sensing star wheels to the program card. One of the spacer studs for the back space ratchet is the drive to the program drum shaft and is anchored in one of the escape gears.

Sensing Star Wheels (Figure 28)

Reading the holes in the program card is accomplished by star wheels. These 5 pointed wheels are mounted in the ends of the sensing lever arms similar to cam follower rollers in the automotive type circuit breakers.

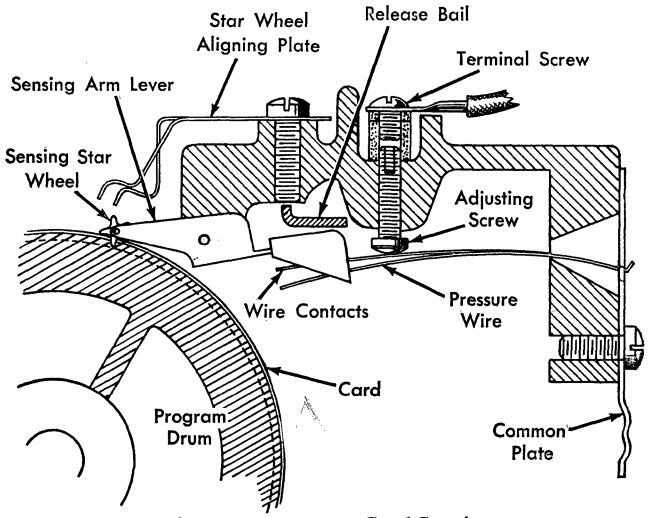


Figure 28. Program Card Sensing

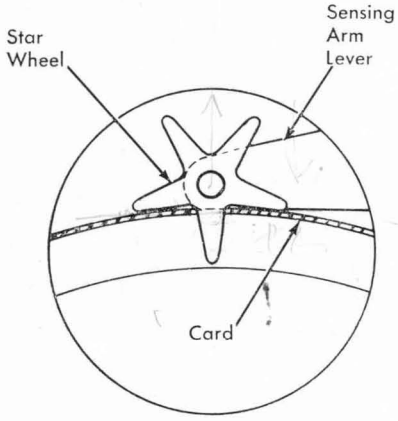


Figure 29. Sensing Star Wheel

A star wheel rides the blank portions of the program card on two of its points. When a hole is reached, the leading point glides into it (Figure 29) and closes the associated program contact at the other end of the arm.

When consecutive holes are being sensed, a star wheel rolls from hole to hole and its contacts remain closed. Advantage is taken of this by using the 12 hole and contact for a hold circuit (field definition) once a function is set up by another star wheel operated contact.

Should a star wheel be permitted to straddle a hole, that column of operation would be lost and in the case of the highest order column of a field the entire field would be affected. The star wheels are aligned against a strip when raised to insure that points will find the holes in the column at which the sensing wheels are lowered.

PUNCH DRIVE UNIT, TYPE 24

THE PUNCH drive unit is driven by a V belt continuous drive through the punch clutch. The clutch is engaged for all punching and pin sensing operations since the sensing pin bail is operated from a cam on the punch shaft. In this manner, punching and reading can take place simultaneously. The punch drive unit is shown removed from the machine in Figure 30.

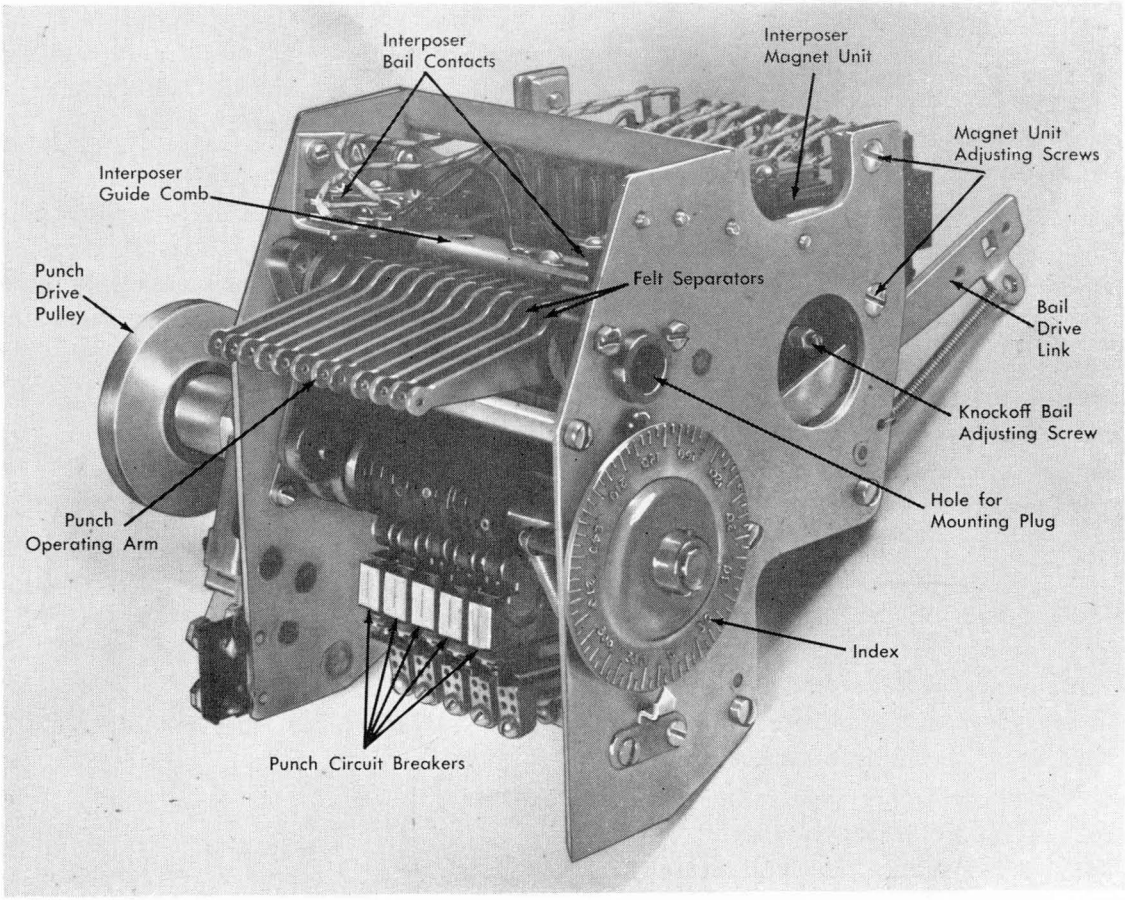


Figure 30. Punch Drive Unit

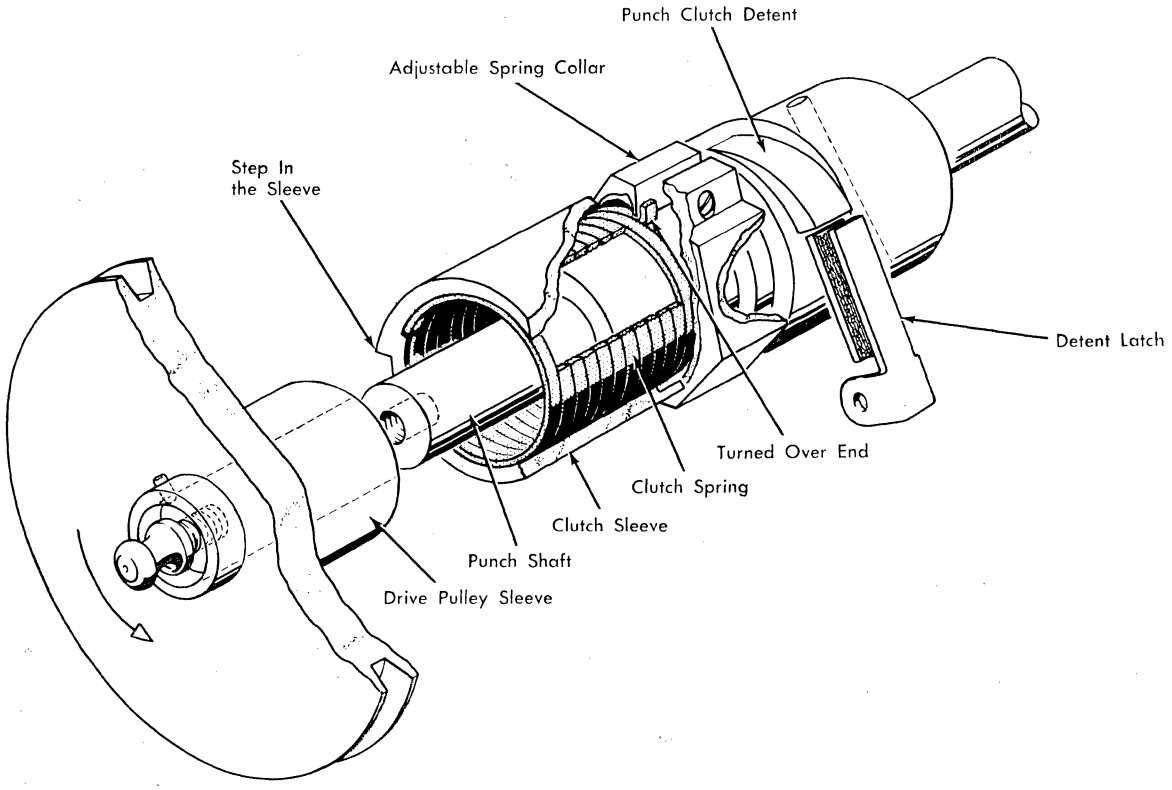


Figure 31. Punch Clutch Assembly

Punch Clutch (Figure 31)

The punch clutch is the friction spring type with a continuously driven pulley and drive pulley sleeve. Normally the drive pulley sleeve rides free on the end of the punch shaft. When the punch clutch magnet de-energizes, its armature latches on the step of the punch clutch sleeve. To latch up the clutch, force is needed. Under normal operating conditions, momentum will carry the shaft to a point where the punch clutch spring will unwind slightly within the clutch sleeve and permit the detent latch to hold the shaft and spring in this position. The clutch spring is anchored to the punch shaft by a clamping collar and a turned-up tip so that when the punch magnet is energized the clutch spring wraps on the drive pulley sleeve, thus driving the punch shaft. The punch clutch latches up at 345° on the punch index.

Punch Clutch Magnet and Detent Latch (Figure 32)

The punch clutch magnet armature and detent latch are of bonded steel and rubber to make their operation quiet and shock absorbent. The same type of armature spring is used on the punch clutch magnet and the card feed clutch magnet.

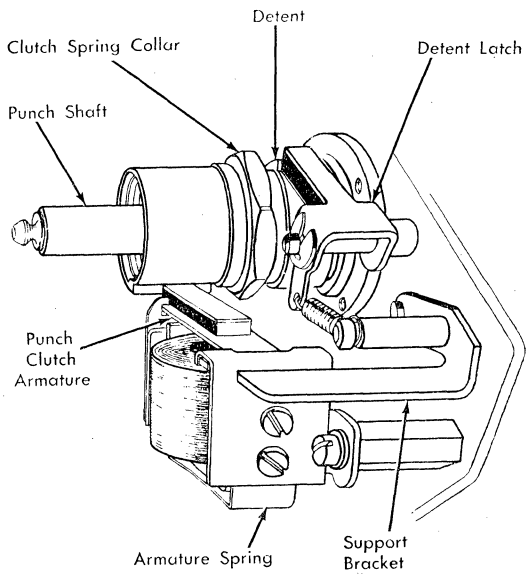


Figure 32. Punch Clutch Magnet and Detent Latch

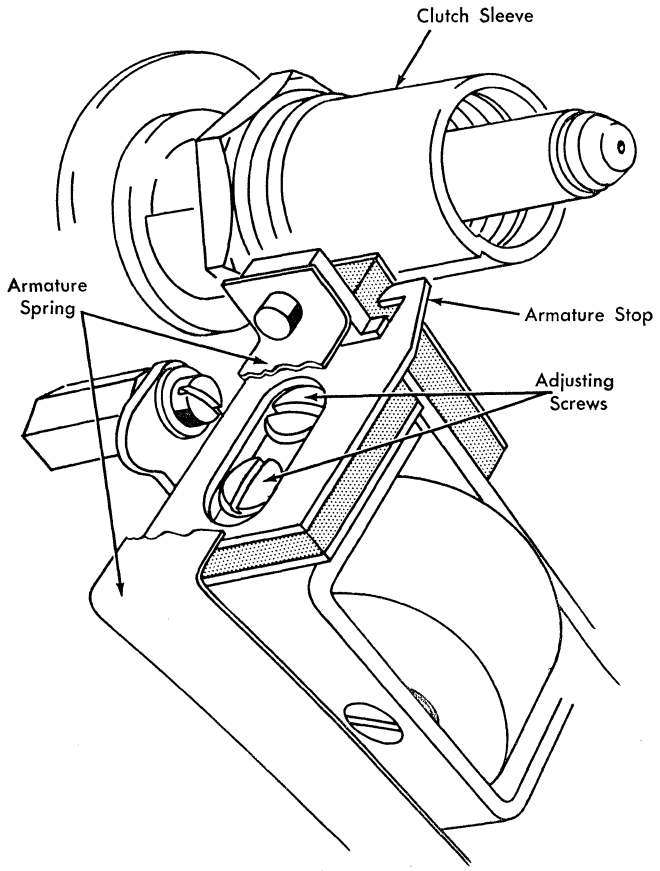


Figure 33. Punch Clutch Armature Stop

The armature travel is controlled by a rubber mounted stop shown in Figure 33 and the operating end of the armature spring is not anchored at the operating end but operates on a guide pin.

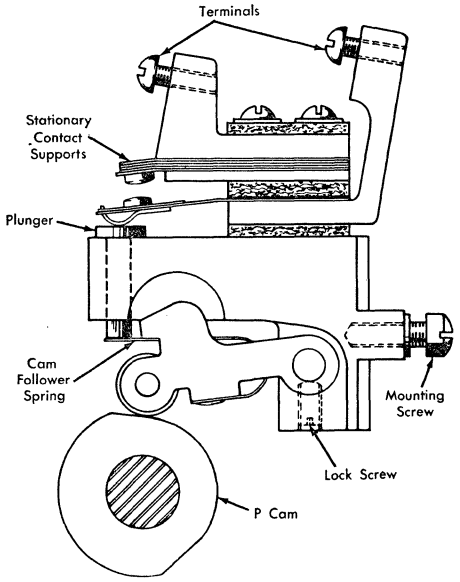


Figure 35. Punch Circuit Breaker

Punch Shaft (Figure 34)

A side view of the punch shaft shows the mechanical and electrical cam location as well as the punch index. *(See the section on the Type 26 for differences in the punch shaft.)*

Punch Circuit Breakers (Figure 35)

As the punch shaft rotates at 1200 RPM it was necessary to design a circuit breaker that would stand this high speed without bouncing. The laminated stationary contact and spring cam follower withstand this speed.

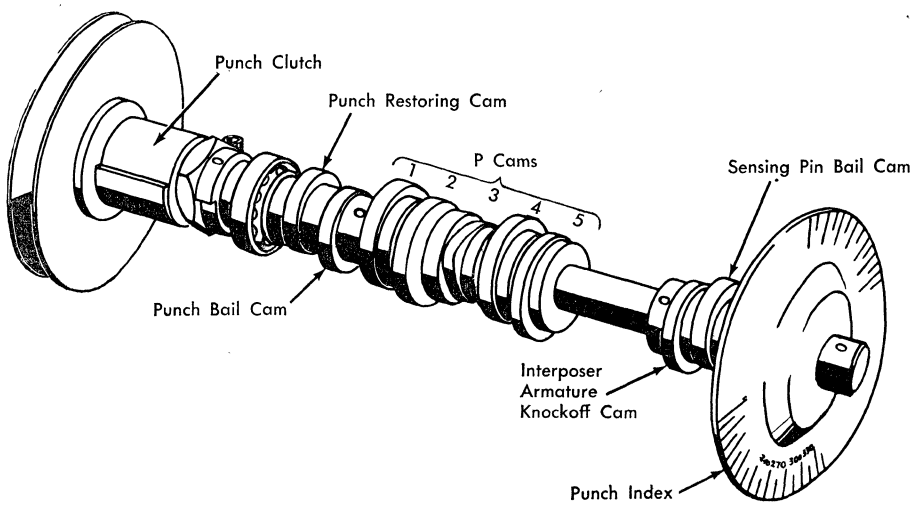


Figure 34. Punch Shaft Assembly

Punching

When a key is depressed, an interposer magnet is energized and its armature attracted. The punch operating interposer following its individual spring closes the interposer bail contact and the interposer latches itself on the punch bail.

Before the card is punched, a series of events take place in order to energize the punch clutch magnet. Depressing a key closes a latch contact and energizes the desired interposer magnet (Figure 36). The interposer magnet armature unlatches its associated punch interposer which latches on the punch bail and closes the bail contacts. As the interposer bail contacts close, they energize the escapement magnet whose armature contact picks up interlock R22. Relay 22 contacts cause the punch clutch to energize after the card has escaped to the column to be punched. Sensing pin contacts can be substituted for the keyboard latch contacts.

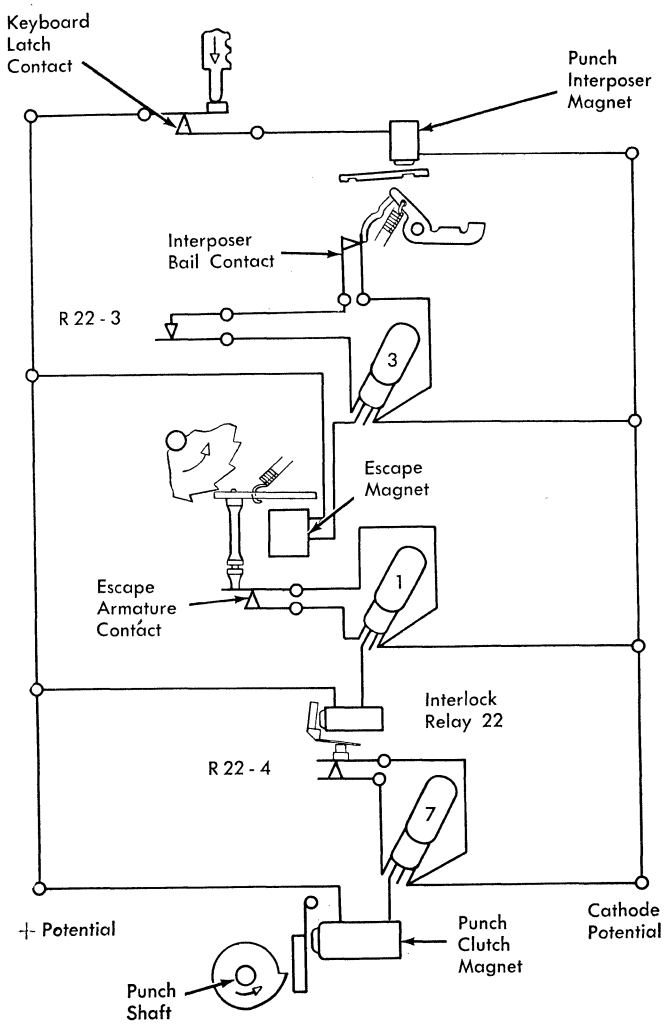


Figure 36. Schematic of Punching from a Key

When the punch shaft rotates (counterclockwise at the clutch end), the punch bail causes the punch operating arm to drive the punch up through the detail card from the bottom (Figure 37). During the completion of the 360° cycle, the punch is restored and if the same interposer magnet is not re-energized, the punch operating interposer over-travels the notch in the armature thereby relatching itself and moving off the punch bail. It can be seen at this time that if the same magnet were re-energized during the punch operation, the punch operating interposer would not relatch on the armature but remain engaged with the punch bail and cause a second punched hole. The latter operation occurs when auto-duplicating the same code in consecutive columns.

The punches strike the card at approximately 93° of the punch index and leave the card at 168°. By restoring the interposer magnet armatures by 36°, the magnets are prepared to be re-energized by the sensing pin contacts when they make at 76°. The punch bail has already started to operate by the time the sensing pin contacts make so that information read on one cycle will not be punched until the following punch cycle. As will be seen in the adjustment section of this manual, the punch operating interposer latch on the punch bail from 252° through 0° when the punch bail is at its highest point of travel. Once the punch operating interposer is unlatched, it must hook on the punch bail in order to be restored on its armature.

Interposer Bail

The interposer bail operates contacts at both ends of the bail to insure a good impulse to the escapement circuits. This bail is operated by any of the 13 interposers.

Space Interposer (Figure 38)

Twelve interposer magnets cause punching by their punch operating interposers latching on the punch bail. The 13th magnet in this unit is the space interposer magnet whose sole purpose is to close the interposer bail contacts and cause an escapement and punch cycle. The punch cycle is essential to restore the space interposer and open the bail contacts again.

Punches and Chip Ejection

Figure 39 shows a cross sectional side view of the punch operation. The punches are ground on a single angle so that the chips will sandwich in the die and be held from falling back into the card. The punches are held to their extensions by a pin which is loose with end

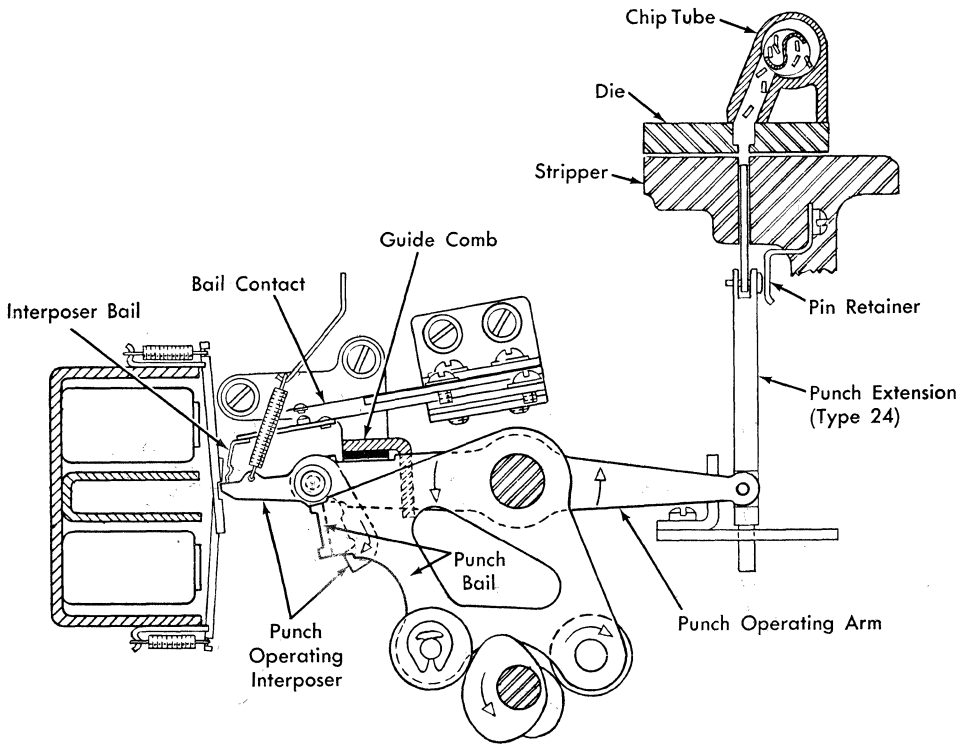


Figure 37. Punch Unit, Clutch Latched

play but held into the punch extension by a retaining plate.

A continuously running shaft drives the ejector blade which is a twisted flat steel ribbon. As the chips are forced into the exit tube, the blade, rotating in such a manner as to carry the chips away from each punch hole, keeps the chips moving to the chip chute and box. Notice in Figure 40 that the die is counterbored on top so that the operating land, on which the chips ride to lock themselves, will hold only three or four chips. (*Refer to the section on the Type 26 for the difference in the punch extension used with printing*). Proper punch travel is very important. NOTE: The ejector blade is coupled to the shaft by a left-hand thread.

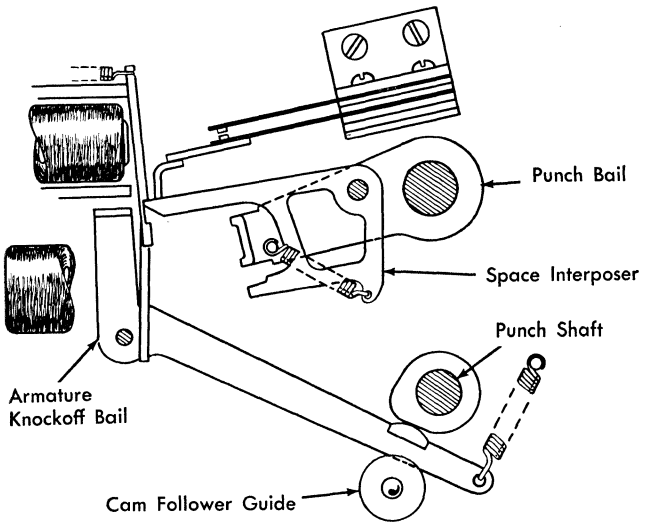


Figure 38. Space Interposer and Armature Knockoff Bail

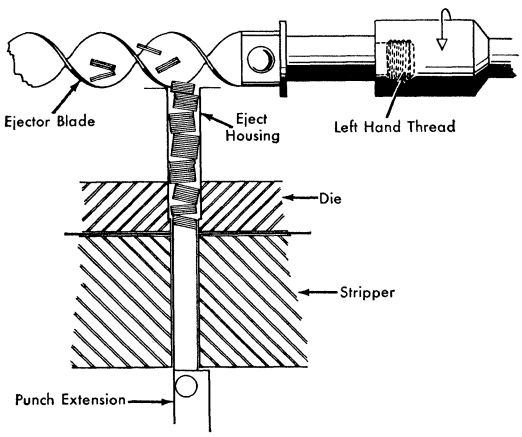


Figure 39. Chip Ejection

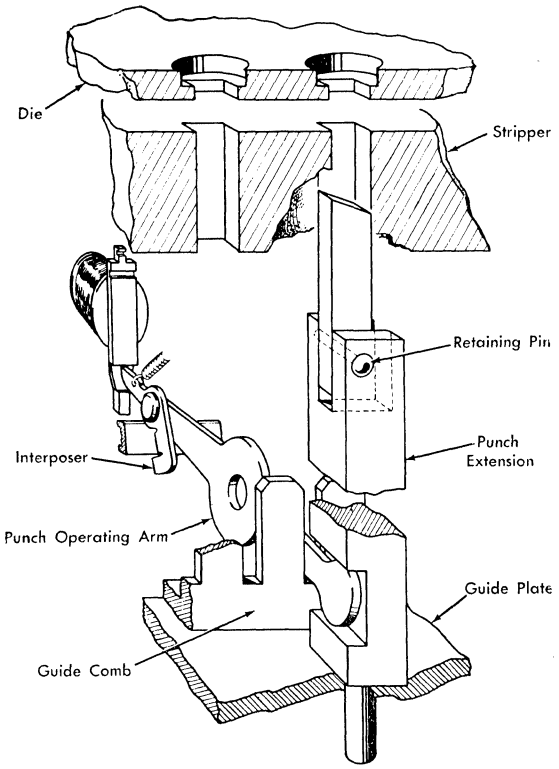


Figure 40. Type 24 Punch and Extension

Punch Interposer Magnets

The punch magnets alternate in polarity to prevent stray punches. There is a difference in resistance values of the interposer magnets of the Type 24 Card Punch and the Type 26 Printing Card Punch. The resistance of the latter (26) is lower for those magnets operating in series with the print relay coils.

PIN SENSING UNIT

AS PREVIOUSLY described with the eject mechanism, a card at the reading station is placed in registration with the column one end. Since it is a general practice to register IBM cards with the column 80 end, any variation manifests itself at the column 1 end. To meet this variation, dual rectangular sensing pins have been adopted which will span .043″ or half the distance from the leading edge of one hole to the leading edge of the next column (Figure 41). A card of proper length will be sensed by both pins as in Figure 42.

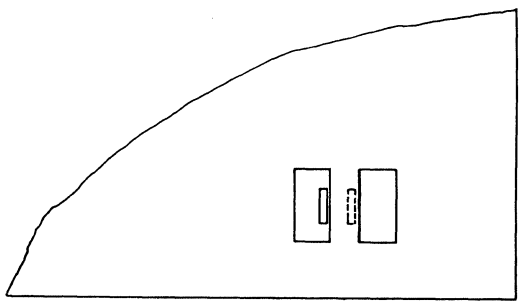


Figure 41. Dual Pin Sensing

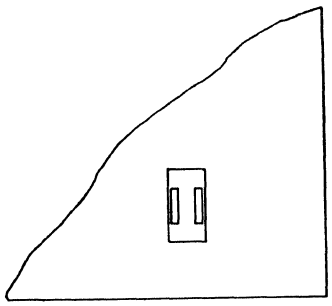


Figure 42. Dual Pin Sensing

A separate contact is provided for each pin thus insuring reading of a column when either pin operates. The 24 contacts make to a common strip and each two associated contacts are common at the terminal end as in Figure 43.

Pin Bail

The sensing pins are raised by the spring tension of their contacts and are retracted by a cam driven bail. As shown in Figure 44 the sensing pin bail cam on the punch shaft raises the pin bail and permits the sensing

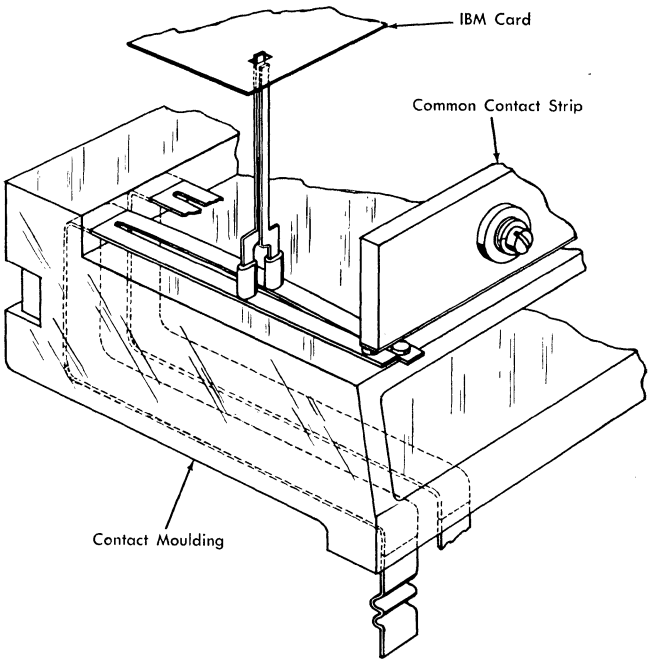


Figure 43. Dual Pin Sensing

pins to seek the punched holes in the master card from pressure of their contacts. The adjustable drive link and the short bail link have been provided with a square hole in each member to permit the insertion of a screw driver when adjusting the sensing unit.

Card Lever

The pin bail drive link spring causes the drive link to follow its operating cam. With no card at the reading station, it is not desirable to pin sense because all the pins would rise and close their contacts. A spring operated card lever (Figure 44) blocks the rise of the pin bail by preventing the drive link cam follower from riding into the low dwell of the pin sensing cam. Thus pin sensing all 12 positions is eliminated while cards are at the punch station only, and the punch clutch magnet energized. With the punch clutch latched up at 345°, the pin bail is lowered, the pins are retracted below their separator guide and the card lever is free to operate.

The removable pin sensing unit, while operated through linkage from the punch shaft, is not essentially a part of the punch drive unit assembly.

Consult the mechanical sequence chart for comparison of punch travel and pin contact duration. The two nearly coincide. Both sensing pins and punches are free of the card by 180° when P1 makes to allow escapement. Notice, that both the punches and sensing pins are positively restored. In spite of this fact, a binding or sticky punch will cause the card to hang up or jam.

Pressure Rails

Cards are guided in their path through the punch bed by the top stationary rail. This rail is pinned to the punch bed at the factory.

The bottom edge of the card is guided by pressure rails. The two spring rails in the reading station have less tension than the ones in the punching station. These pressure rails greatly affect registration and card buckle. Be certain to check the adjustment section before attempting to change them.

COMBINATION KEYBOARD

THE PRINCIPLES of operation are identical for the numerical and combination keyboards. Therefore, a discussion of the combination keyboard with its maximum capacity should cover all features.

Key Operation

The reason a short depression is needed to operate the keys may be seen in Figure 45. The depression of

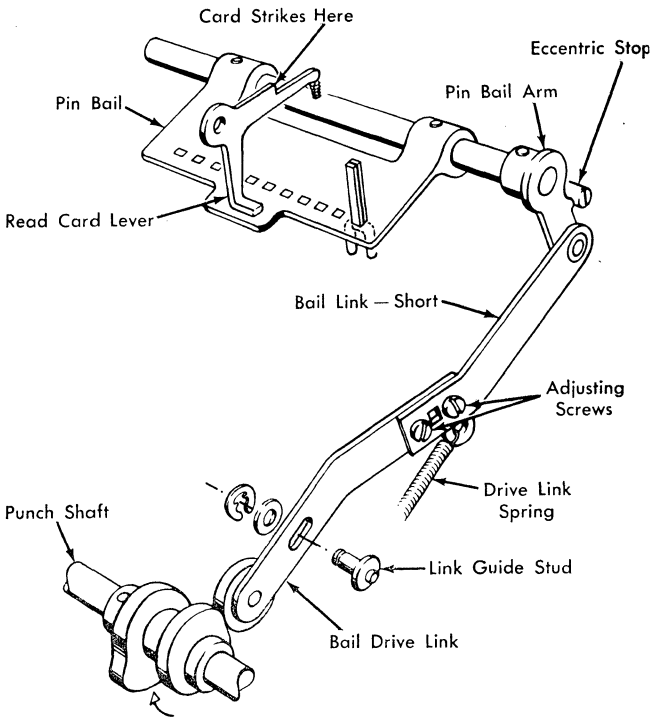


Figure 44. Sensing Pin Bail

a key causes the key stem bell crank to move its latch pull bar forward which causes the latch assembly to drop off the latch bar. Individual key stem springs restore the keys and pull bars to normal. A separate flat spring holds each pull bar against its latch assembly and insures its relatching in the notch in the latch.

In Figure 46, notice that the latch assembly is made up of three parts which, although attached by a rivet, are free to rotate about this point. Each part has its

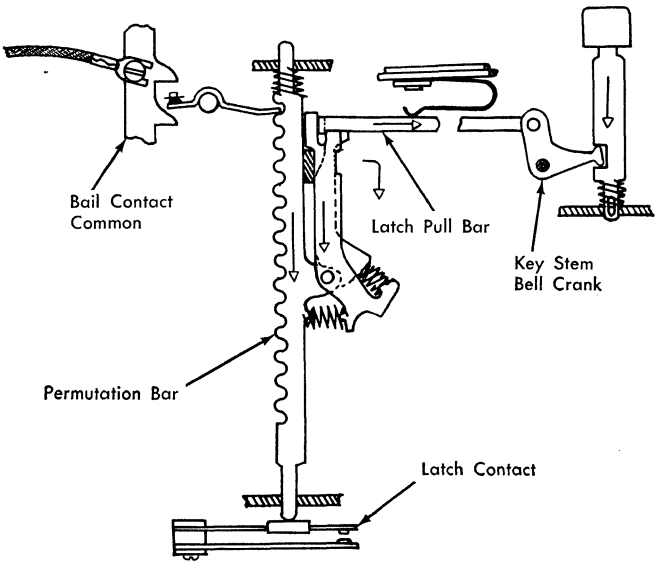


Figure 45. Keyboard Latch Normal

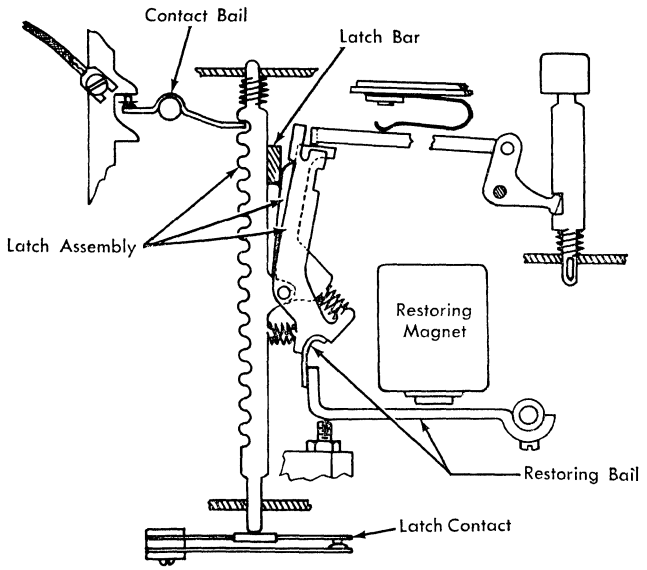


Figure 46. Keyboard Latch Tripped

separate functions. The permutation bar supports the operating spring and causes the contact bails to pivot and close the bail contacts, while some of them operate latch contacts. The latch hooks over the latch bar and holds the latch assembly plus its permutation bar inoperative until desired.

The check lever slides over the notch in the latch

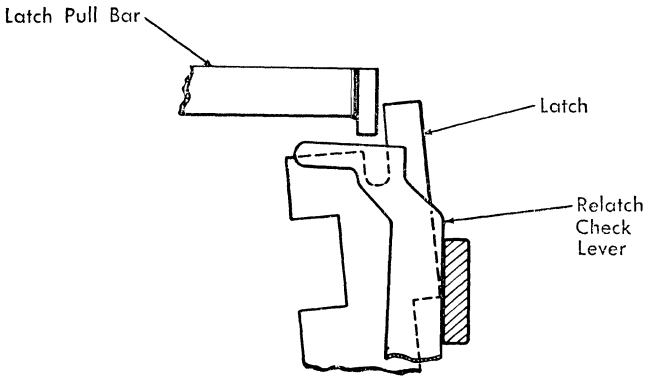


Figure 47. Relatch Check Lever

to block a second operation before the latch assembly is fully restored (Figure 47).

Disc interlocks which are operated by the latches prevent tripping more than one latch assembly at a time.

The pull bar guide has "L" shaped separators which hook under the pull bars as in Figure 48 to aid in disassembly of the keyboard.

As each key stem is returned to its normal position, it comes to a stop against a steel wire threaded through the slot in each key stem. The wires are provided to aid in disassembly of the key unit.

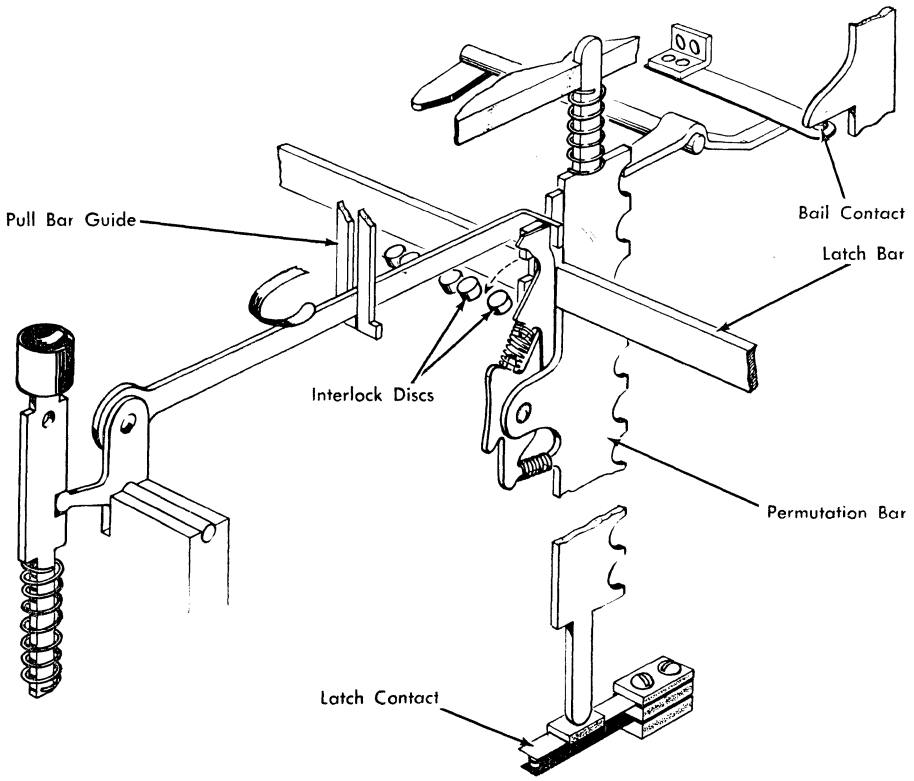


Figure 48. Keyboard Operation

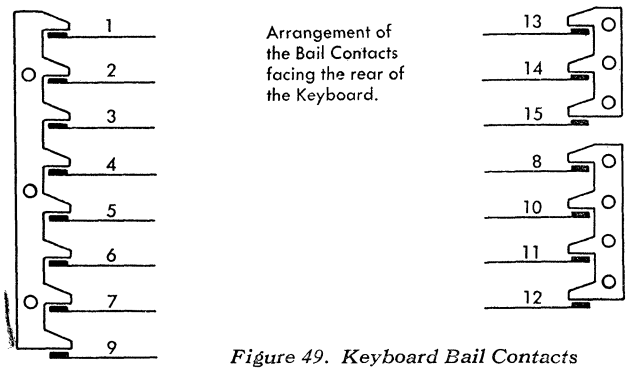


Figure 49. Keyboard Bail Contacts

Keyboard Restoring

In Figure 46 notice the position of the restoring bail. This bail rests under all latches and rehooks the latches on the latch bar.

In addition to restoring latch assemblies, the restoring bail operates its contact which breaks the common to all the keyboard latch and bail contacts. The restoring bail contact breaks before the other keyboard contacts and is, therefore, the only keyboard contact protected by a series capacitor resistor.

Two restoring magnets operate their armatures at either end of the restoring bail. Two magnets are used because under some operating conditions these magnets and bail hold the keyboard locked up, for example on feed cycles, to prevent punching in the event the first field of the new card was to be auto-duplicated. Releasing the keyboard restoring magnets after the program has had time to read gives the program control precedence. These magnets restore when the machine is first turned on in the event a key was tripped while the machine was turned off.

Keyboard Codes (Figures 49 and 50)

All permutation bars do not operate both latch and bail contacts. Notice that the 9 key operates only the *9 latch contact* while the 8 key causes the number *13 bail contact* to close (Figure 49).

For location of the bail contacts consult Figure 49. This information is also found on the machine wiring diagram in sections 7 and 8. The contact bails are numbered in sequence with 1 at the top to aid in installation and removal and are not necessarily the number of their associated contact. Bail number 6 operates bail contact number 15 which is used with the special character feature only; therefore, it will not be found in keyboards without this feature.

An example of a normal contact operation is as follows:

KEY OPERATED	BAIL CONTACT OPERATED	LATCH CONTACT OPERATED	STEM CONTACT
A	12 1		
B	12 2		
I 2	12 9	2	
J 4	11 1	4	
K 5	11 2	5	
L 6	11 3	6	
M 7	11 4	7	
N	11 5		
O 3	11 6	3	
P &	11 7	&	
Q	11 8		
R	11 9		
S	10 2		
U 1	10 4	1	
Z	10 9		
8	13		
9		9	
ZERO	14	ZERO	
@ #	13 - 15		
% ,	13 - 14 - 15		
* $	13 - 15	*	
¤ °	13 - 15	¤	
REL		REL	
SPACE		SPACE	SPACE
- SKIP		- SKIP	
DUP.			DUP.
ALT. PROG.		ALT. PROG.	
FEED		FEED	
SKIP		SKIP	
REG		REG	
AUX. DUP.		AUX. DUP.	
ALPH.			ALPH.
NUM.			NUM.

Figure 50. Combination Keyboard Contact Codes

Depressing the U-1 key will close bail contacts 10 and 4 in addition to latch contact 1. Depending upon whether the keyboard is alphabetic or numerical, either the 0 and 4 interposer magnets will be energized for the letter U or the 1 interposer magnet for the numerical one.

Therefore, each time a key is operated, all its individual contacts will close but only those controlled to operate by keyboard shifting will energize interposer magnets.

The numerical, alphabetic, and duplicate keys operate key stem contacts *only* as shown in Figure 51.

The space bar operates both a latch contact and a key stem contact. The key stem contact permits multiple punching in one column even though the latch contact is broken as long as the space bar is held down.

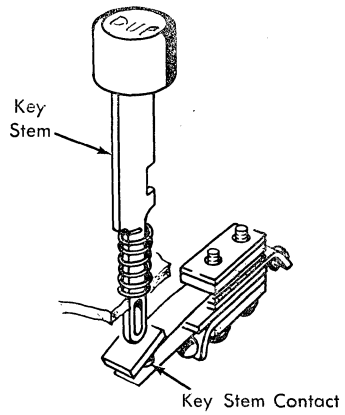


Figure 51. Key Stem Contact

KEYBOARDS

TO REMOVE the keyboard from the machine it is necessary to pull out the permanent lugs in the terminal panel. With the combination keyboard, the wires will be filled in solid starting from the top of the panel. With the numerical keyboard it is advisable to note the vacant hubs before removing the cable even though the cable forms are laced out for each location.

Covers

To remove the bottom cover from the keyboard slip off the rubber base ring and the bottom plate will come with it. Four screws hold the unit in the top cover. Two are in the switch plate and one on either side of the key unit. All are accessible from the bottom of the keyboard.

When replacing the base cover and base ring, by placing the ring on the bottom cover first and taking care to stretch the ring before each corner is turned, the assembly is easily attached to the top cover starting at the joggle plate side of the keyboard. The curled edge of the bottom plate should face out.

To Remove the Key Unit (Figure 52)

To separate the keyboard into its major units, remove the four screws as shown in Figure 52. In separating these assemblies, be careful when sliding the key unit out of the permutation unit as the "Y" pull bar will hook on the center support screw. It is not necessary to remove any wires if this removal is merely for inspection. To reassemble, reverse the procedure.

NOTE: Do not oil or grease the hook ends of the latch pull bars.

To Remove a Key Stem

1. Separate the key and permutation unit as described above and stand the key unit on the front end.

2. Pull the wire stop out to free the key stem desired.

3. Pull out on the pull bar of the desired position to free the key stem bell crank and the key will follow out the top of the key unit. The round hole at the top plate permits removal of the key stem and its spring. Be careful that the spring does not drop into the unit.

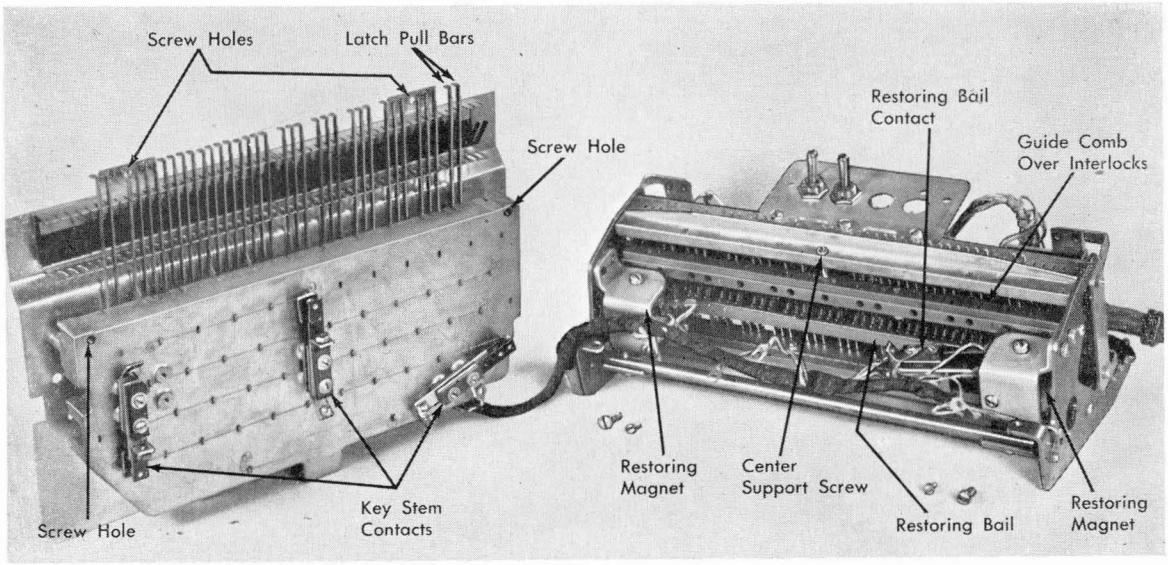


Figure 52. Key Unit

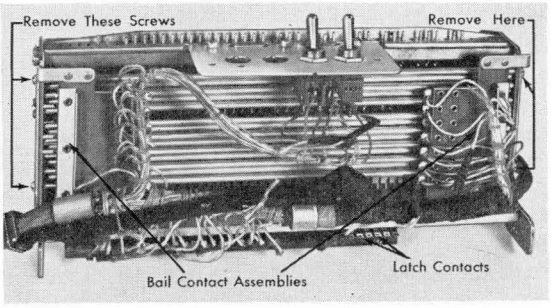


Figure 53. Keyboard Permutation Unit

To reassemble, reverse the procedure. Be sure to replace the grease on the pull bars at the "L" guides and springs but not on the hook ends which should be dry.

To Remove a Latch Assembly (Figure 53)

1. Separate the key unit and permutation unit as described under *Removal of Key Unit.*
2. Remove the wires from all the key stem contacts.
3. Loosen the two mounting screws and remove the restoring bail contact assembly.
4. Take out one screw from one of the restoring armature pivots and swing the pivot block away from the armature.
5. Remove the restoring bail.
6. Remove the two bail contact assemblies shown in Figure 53. Each assembly is held by 2 screws.
7. Remove the three screws holding the toggle switch assembly.
8. Remove the contact bails by sliding each bail sideways then pivot the other end out. These bails are numbered 1 - 15 top to bottom (Figure 54).
9. Remove the latch contact mounting bar (four screws).
10. Remove the four screws from the bail stop plate which forms a retaining guide comb for the bottoms of the permutation bars (Figure 54). If the four adjusting screws are not tampered with, readjustment can be avoided on this assembly.
11. Remove the center support shoulder screw from the upper latch assembly guide.
12. Now turn the unit upside down and with your fingers hold the guide comb over the interlocks while removing the three screws which hold it from the bottom. The large screw is only a pilot; do not remove it.
13. Still holding the guide, set the assembly right side up on its longest flat sides as shown in Figure 52.
14. Lift off the interlock guide comb exposing the interlock discs.
15. Lift out the interlock discs adjacent to the latch assembly to be removed and the latch assembly is free to come out the bottom.
16. Be sure to remove the two tension springs on the latch assembly or the latch and check levers will slip out past the latch bar and the springs will be lost.

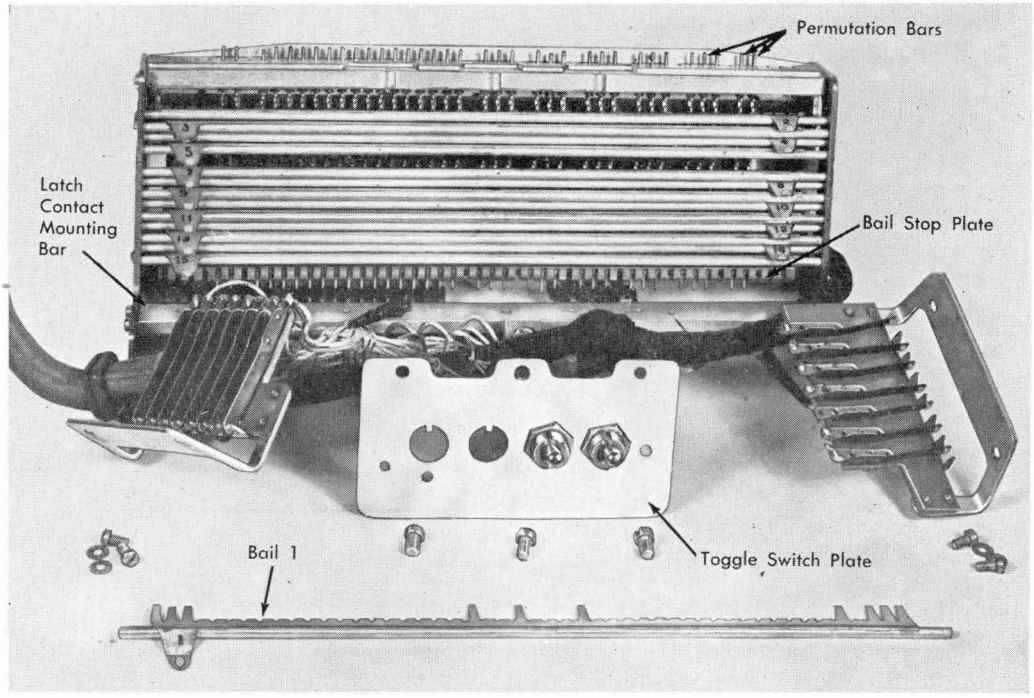


Figure 54. Keyboard Bail Unit

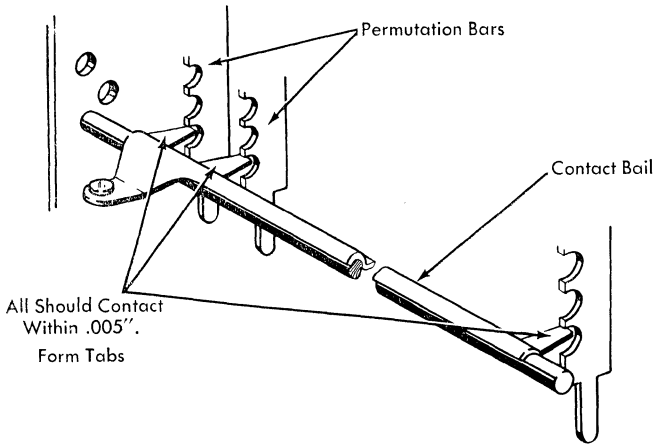


Figure 55. Contact Bail Adjustment

CAUTION: All parts in direct contact with the interlocks must be free of oil or grease including the latches which strike the interlocks.

When an interlock is removed, all latches which are tripped off the latch bar can fly out. With reasonable care, the latch assembly with springs on may be gripped just below the latch bar and removed or inserted without dislodging other latches. If an additional latch assembly falls out, its position may be verified by checking with the pull bar positions.

To reassemble reverse this procedure and adjust.

Contact Bails Adjustment (Figure 55)

With all the latch assemblies restored, the tabs on each contact bail must all have a clearance of .000" to .005" with any tooth on its associated permutation bars. Bend individual tabs on each bar to meet this condition.

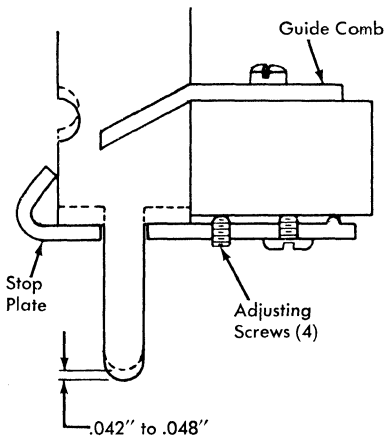


Figure 56. Permutation Bar Stop Plate Adjustment

Pull Bar Support Bar Adjustment

The pull bar support bar must be parallel with the interlock guide directly beneath it, along their longest parallel edges within .008". Clearance in its three mounting screw holes provides adjustment.

Permutation Bar Stop Plate Adjustment (Figure 56)

When a key is depressed, its corresponding permutation bar must drop .042" to .048". This is to be checked at the fourth latch position from either end and at the central latch position. Adjusting screws are on the bail stop plate.

Restoring Magnet Adjustment (Figure 57)

With the restoring magnets energized and all latch assemblies restored, the armature must touch the magnet cores and the restoring bail must touch the lowest latch arms. Adjust the two magnet mounting screws on the outside of the side frames. Inspection holes are provided to check this adjustment.

With the latch restoring magnets de-energized, there must be a minimum of .002" (a crack of light) clearance between the restoring bail and the latch arm when any latch assembly is pulled off the latch bar. Adjust the two brass restoring bail stop screws.

If adjustments of the stop plate, restoring magnets, and the backstop screws have been made correctly, the clearance between the armatures and their cores measured at the center line of the core is a maximum of .030".

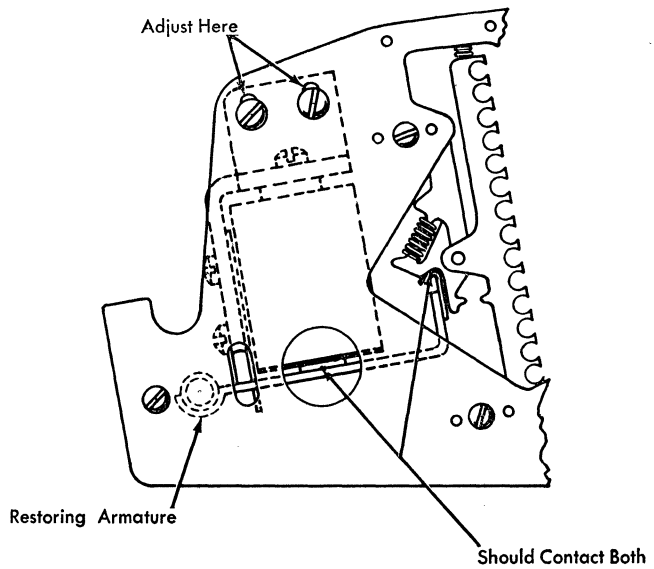


Figure 57. Restoring Magnet Adjustment

Bail Contacts Adjustment

The bail contacts must have an air gap of .015″ to .025″ when the latch assemblies are restored. Adjust the contact plate assemblies by their mounting screws on the side frames.

Restoring Bail Contact Adjustment

The restoring bail contact should be closed when the restoring magnets are de-energized. The contacts should have a gap of .015″ to .020″ when the restoring magnets are energized. This contact should break before any other keyboard contact and is the only one protected by a spark suppression circuit.

Key Stem Contacts Adjustment

The ALPH, DUP and space bar key stem contacts should have a minimum gap of $\frac{1}{32}$″ when open and a deflection of $\frac{1}{64}$″ of the stationary strap when closed. These contacts should close with a depression of their key stems of $\frac{1}{32}$″ to $\frac{3}{32}$″. In addition to the above, the space bar contact should make before its associated latch assembly trips off the latch bar. Bend the contact support to obtain this adjustment.

Numerical Key Contact Adjustment

The numerical key stem contact should have a minimum air gap of $\frac{1}{32}$″. When the key is fully depressed, the stationary strap should require a minimum pressure of 15 grams to break the contact when measured at the end of the strap. The support strap can be bent or the stationary strap can be formed to obtain this adjustment.

Latch Contact Adjustment

The latch contacts should have an air gap of .015″ to .025″ when the latch assemblies are restored. To obtain this gap adjust the steel bar support mounting screws in the side frames. Be certain that the contacts make properly because these contacts have small radii.

Card Registration Adjustment (Figure 58)

Card registration in the punch station is to be set by trial.

1. Move the eccentric stud in the card pusher cam follower so that it will not interfere with the movement of the card pusher arm.

2. Adjust the card pusher pad to extend above the surface of the base sufficiently to prevent overthrow of the card. Position the pad to provide a minimum of .010″ from the edge of the base to the pad. When the pad is properly adjusted and when the card pusher is over the pad, there should be only a slight drag on the card when it is pulled straight out.

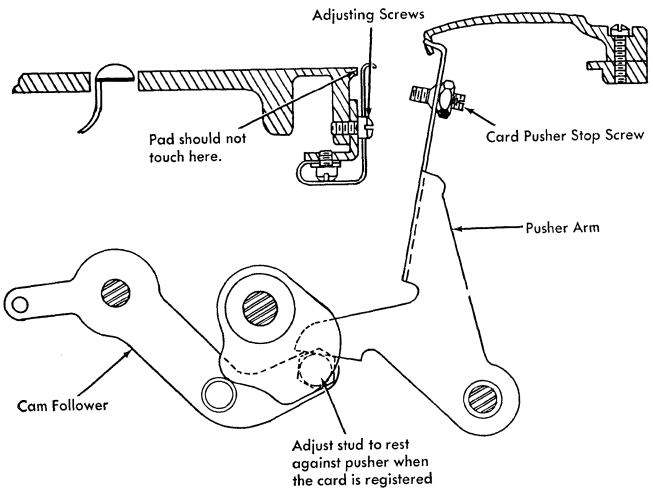


Figure 58. Card Registration Adjustment

3. Adjust the stop screw in the card pusher arm to obtain proper punching registration.

4. Turn the card feed over by hand until the pusher cam follower is on the high dwell of the cam (50°). Adjust the eccentric stud in the cam follower to just touch the card pusher arm.

Die Card Lever and Switch Adjustment (Figure 59)

1. Shape the formed ear on the card lever to extend the card lever button $\frac{3}{32}$″ above the punch bed.

2. Position the switch mounting bracket and switch mounting screws to operate the switch when a card is inserted by hand.

Pressure Roll Adjustment

1. With the card stop cam follower on the high dwell (approximately 35° of CF index), adjust the eccentric screw (Figure 60) in the cam follower for an opening of .030″ to .035″ between the punch station pressure roll and serrated roll.

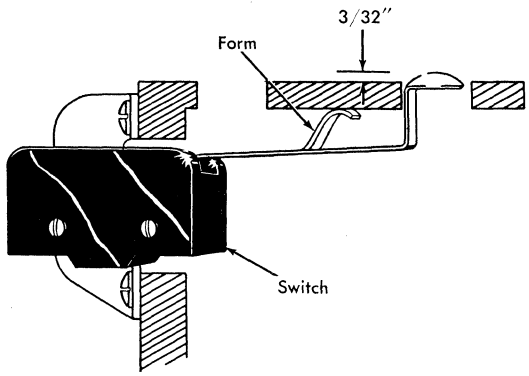


Figure 59. Die Card Lever and Switch Adjustment

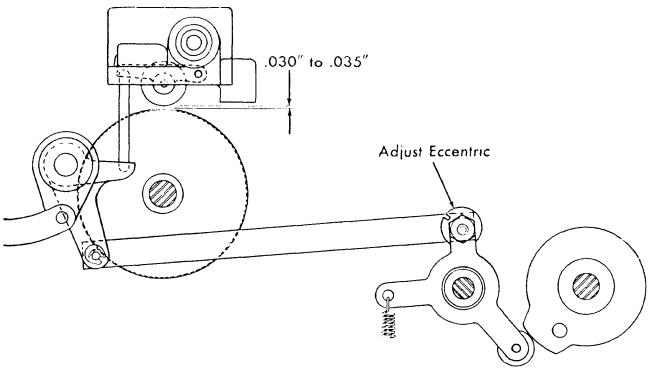


Figure 60. Punch Station Pressure Roll Adjustment

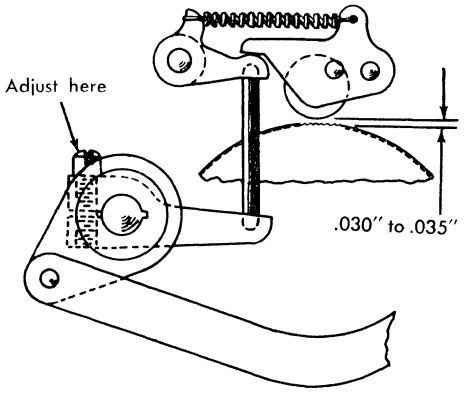


Figure 61. Read Station Pressure Roll Adjustment

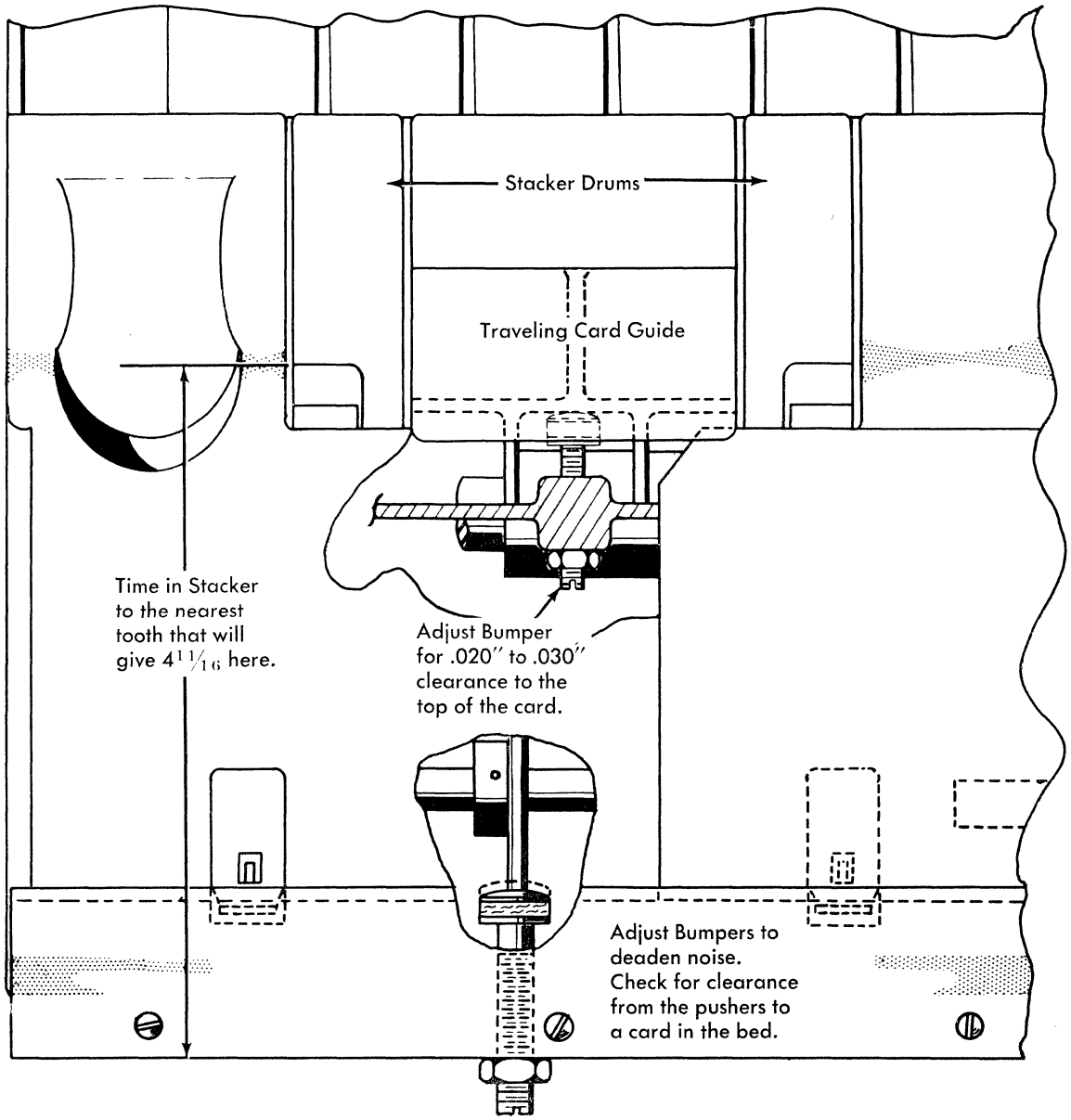


Figure 62. Stacker Unit Adjustment

2. Still on the high dwell of the cam after adjustment 1 has been checked, the reading station pressure roll should have a clearance of .030″ to .035″ to the serrated roll.

Adjust by means of the split block. This adjustment should be held close because the motion that opens the pressure roll also operates the eject mechanism (Figure 61).

Stacker Unit Adjustment (Figure 62)

1. With the CF clutch latched up at 0°, time the stacker assembly gears to the nearest tooth that will provide a measurement of $4\frac{11}{16}$″ from the front of the bed casting to the top of the cut in the stacker drums.

2. Adjust the traveling card guide bumper for a clearance of .020″ to .030″ from the top of the card to the guide. Be sure that the card is under the front rail when checking this adjustment.

3. The front stacker bumpers should be adjusted so that noise which is due to the excessive overthrow is eliminated. Check to see that the top bumper does not cause the stacker pusher fingers to interfere with the card travel.

4. The gripper finger blocks should touch the opener cams evenly at 70°. This should cause a grip on the cards by the fingers of approximately $\frac{3}{16}$″.

5. The lower opening cams should release the card being stacked without injury to it. This condition should result from setting the lower opening cams to contact the finger blocks when the ends of the fingers are ⅛″ from the stacker plate as shown in Figure 63.

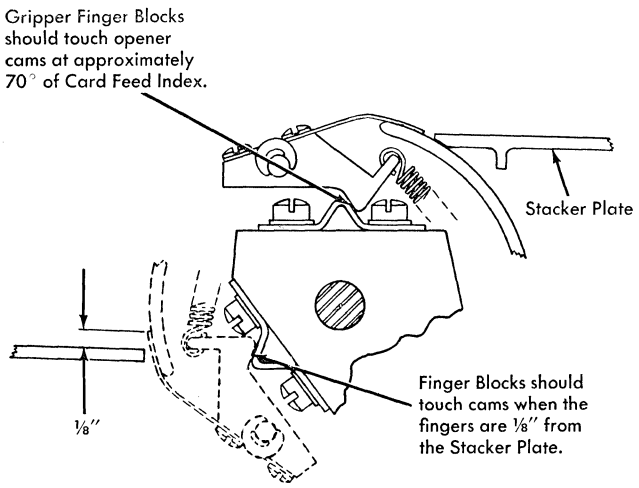


Figure 63. Gripper Finger Adjustment

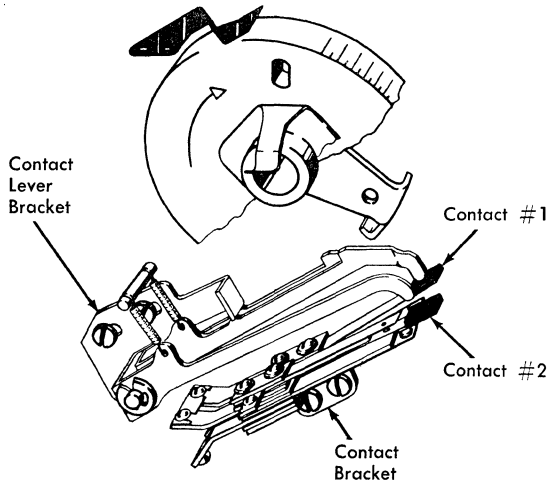


Figure 64. Program Cam Contact Adjustment

Back Space Adjustment

1. Position the back space ratchet by means of its three screws in elongated holes so that the card will be back spaced into column 1 but not into column 88.

2. The escapement wheel teeth should be reversed ½ tooth past their normal latching positions.

3. Adjust the back space switch so that it will operate with $\frac{1}{16}$″ depression of the back space key.

Program Cam Contacts Adjustment (Figure 64)

The timings for these assemblies are given with respect to the column indicator but are made and checked by the relationship of the corresponding escape wheel teeth to the the escapement armature. Turn the machine ON, and check the following while holding the escape wheel by hand.

1. Cam contact 1 (inner) should break at column 88⅙ (⅚ of a tooth before column 1) and should make at column 80⅓ to 80⅔ (Figure 65). When the escape armature drops into the tooth at 88⅙, the

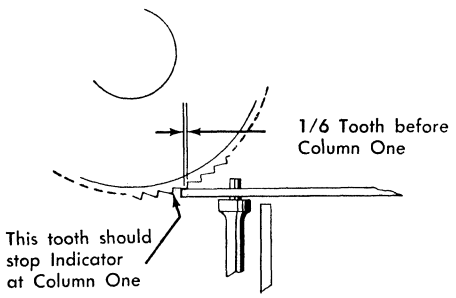


Figure 65. Program Cam Contact Timing

column indicator will stop at column one as the armature bottoms in the tooth.

2. Cam contact 2 (outer) should break at column 81½ to 83 and make between columns 87½ and 88½. This should be checked by holding the escape wheel by hand as column 80 is manually punched while watching the escape armature for relationship to the escape wheel teeth.

3. The contacts should have a minimum air gap of .020" and $\frac{1}{32}$" rise after making. Shift the contact mounting bracket and form the contact support to obtain these conditions.

To obtain items 1 and 2 above, shift the contact operating lever bracket. The mounting screw holes are elongated to provide lateral adjustment.

Be certain to check this adjustment after the change of the adjustment of the program drum forked arm as the adjustment will affect the relationship of the escapement wheel teeth to program cam.

Pressure Rails Adjustment (Figure 66)

1. Tension the two pressure rails in the punch station to exert a pressure of 23 to 27 grams each on a card in the punch bed.

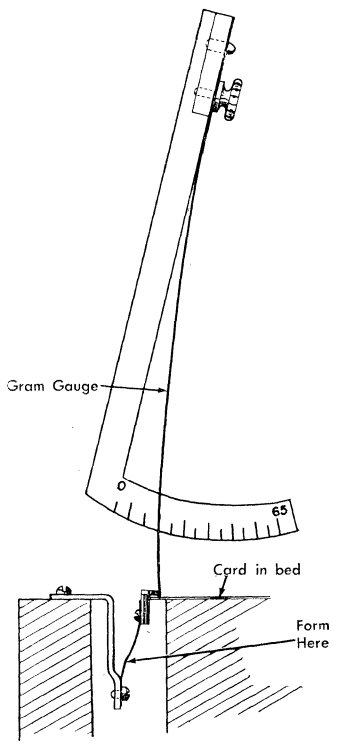


Figure 66. Pressure Rail Adjustment

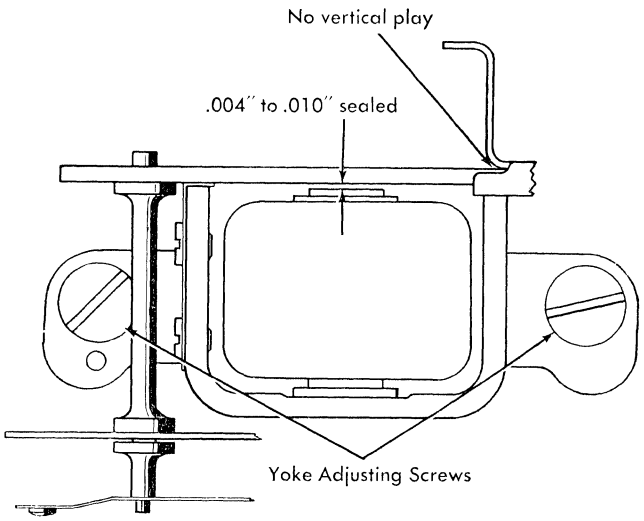


Figure 67. Escapement Magnet Adjustment

2. Tension the two pressure rails in the read station to exert a pressure of 13 to 17 grams each on a card in the bed. Check the above by the tension required to move the rail free of the card when measured at the center of the lip on the rail.

Escapement Magnet Adjustment

1. Rotate the escape magnet about its pivot pin so that with the operating end of the armature against the magnet yoke, the pivot end of the armature will have no vertical play and will be free of binds. This adjustment is made with two yoke mounting screws (Figure 67).

2. There should be an air gap of .004" to .010" from the armature to the core with the armature sealed.

3. Shape the armature spring support to require 130 grams to seal the armature with the contact operating stud removed.

4. The auxiliary armature spring (Figure 68) should exert 250 to 275 grams toward the stop stud. Split ends should contact the stop stud evenly.

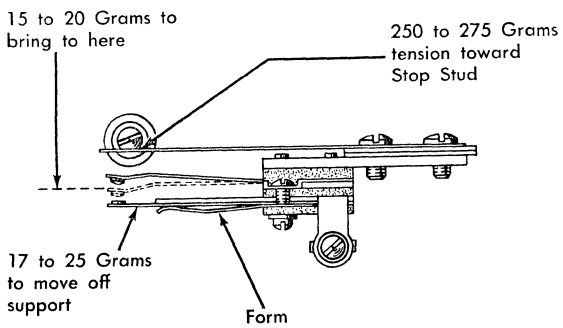


Figure 68. Escapement Armature Contact Adjustment

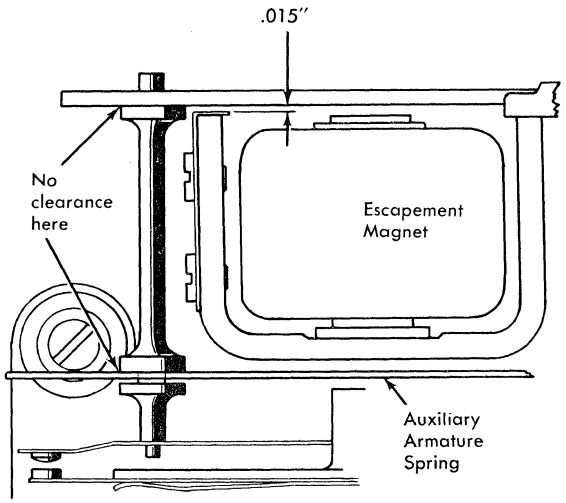


Figure 69. Escapement Contact Bracket Adjustment

5. It should require 17 to 25 grams to move the stationary contact off its support. To adjust, bend the stiffener spring but do not kink.

6. It should require 15 to 20 grams to bring the O/P to a horizontal position. After adjustments 4, 5, and 6 install the operating pin by unscrewing the top stud.

7. By means of the two contact bracket screws, position the escape contact bracket so there is no clearance either from the contact operating pin to the armature or the auxiliary spring when there is a clearance of .015" from the armature to the yoke as in Figure 69.

NOTE: If the above adjustments are properly made, the operating pin should be free in the escape armature, auxiliary spring, operating strap and strike the escape armature squarely.

8. With an .008" gauge between the escape armature and yoke, the escape contact should just make. To adjust, bend the stationary contact support.

9. With an .008" gauge between the escape armature and yoke, position the entire magnet and contact assembly by pivoting about its pin so that all teeth of the escape wheel will just clear the armature tip. With a .009" gauge the same condition should cause the high teeth to strike the armature.

Removal of the Program Sensing Unit

If this unit is to be removed, it is advisable to do so as an assembly by taking out the two screws holding the unit to the base casting. If it should be desired to separate the plastic top plate which supports the sensing wheel arms, scribe a line along its left edge to insure its proper relocation. The contact duration and timing are easily lost by removing the top plate.

When the assembly is reinstalled on the base, the shoulder on the sensing assembly seats firmly on the base and a locator pin insures proper lateral placement.

Program Sensing Unit Adjustment

1. Multiple punch a program card 12 through 9 in columns 1 and 3 and install it on the program drum. Be sure this card is punched in proper registration. Space into column 2 and lower the sensing wheels. Adjust the top plate so that the wheels align vertically to the program card and when the wheels roll into a hole, the sensing wheel arms touch the program card.

2. Punch a second program card with an 11 in column one followed by three 12's and install on the program drum. With the machine standing in column one, pick up R3 and lower the sensing wheels while holding the escape wheel. The escapement armature should drop back and overlap from ⅓ to ½ of the tooth. To adjust shift the relationship between the space gears and the program drum by means of the forked arm and adjusting screws behind the back space ratchet. If step 2 is properly made, all the program contacts will make and break at the same time on an escapement.

3. The sensing wheel contacts should be adjusted to just make when the wheel bottoms in a hole. Add ⅜ turn more to give the wire contacts the correct rise.

To adjust, remove the terminal screw, loosen the locking collar and turn the Bristol screw inside the collar. This adjustment is close and the greatest accuracy is obtained by having the locking collar only loose enough to permit turning.

PIN SENSING UNIT

Removal of the Pin Sensing Unit

Pull the bed detent pin and tilt the bed forward to the vertical position. If the machine is not equipped with the auxiliary duplicating feature, step 6 can be performed from the bottom of the base before step 5.

1. Disconnect the pin bail drive link at its coupling screws through the hole in the rear of the punch bed. Do not remove the spring from the link to the drive unit rear frame. See Figure 77 for the location of these screws.

2. Remove the eject mechanism from the top of the sensing pin unit by its two mounting screws. Pick

out the release pin which operates the eject mechanism. It is free to fall out.

3. Remove the two screws holding the stacker plate to the stacker assembly near the stacker switch.

4. Remove the three screws holding the eject front rail. Beneath this rail are two screws holding the stacker plate to the base. Remove these and lift off the stacker plate.

5. The two remaining screws in the top of the pin sensing unit when removed, will free the unit. Lift out the unit from the top of the base.

6. With a pair of long nose pliers, pull out the common wire to the sensing contact strip and the slip connections to the individual terminals. Note that cable is fanned out from the rear of the machine forward. To assemble, reverse this procedure.

Removal of a Sensing Pin

Remove the pin sensing unit from the machine as described above and proceed as follows:

1. Trip the card lever and place the sensing pin unit upside down.

2. Remove the two screws holding the contact assembly to the frame and lift it off. This exposes the operating ends of the sensing pins. Use care to avoid moving the contact bail because it is possible to lift all the sensing pins out of the separator and considerable time will be spent replacing them.

Pin Sensing Unit Adjustment

With the unit removed from the machine, the adjustments are as follows:

1. Place the eject mechanism against the pin sensing unit in its normal operating position. Operate the pin bail arm against the eccentric stop and insert a blank IBM card in the reading position. With the bail arm released so the pins will strike the card, adjust the common contact strip for an air gap of .020" to .025" to the closest contacts across the entire unit (Figure 70).

NOTE: Do not bend the individual contact sideways because they will fracture, thus causing breakage under operation.

2. Loosen the lock screw in the casting to free the eccentric stop. Operate the pin bail arm against the eccentric. Turn the eccentric to permit sufficient travel to the pin bail arm to retract the sensing pins from .010" to .015" below the surface of the plastic separator guide. Lock the setscrew.

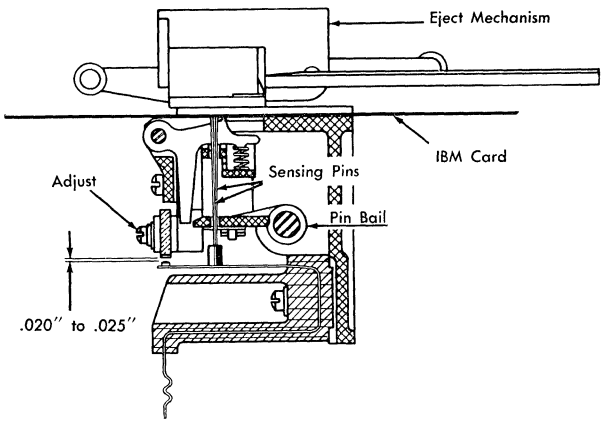


Figure 70. Pin Sensing Unit Adjustment

3. The read card lever should be adjusted by means of its two mounting screws to clear the pin bail by .005" to .010" when the pin bail arm is against the eccentric stop.

Check to see that the sensing pin contacts make before and break after P5. This cam is the circuit breaker for the sensing pin contacts, and changing the eccentric stop will shift the duration time of the sensing contacts.

Pin Sensing Drive Link Adjustment

This adjustment must be checked each time the punch travel is changed. With the punch clutch latched up at 345°, adjust the drive link screws (through the hole in the bed behind the card feed clutch assembly) by inserting a screwdriver in the slot in both links and extending the pin sensing drive link until the pin bail arm rests against the eccentric stop. Do not force the pin bail arm against the stop. This link operates on every punch shaft revolution and excessive pounding against the eccentric stop will cause damage to the unit.

CARD FEED UNIT

Feed Clutch Adjustment

1. Adjust the armature spring by forming to exert a tension of 100 to 120 grams in the direction of A and 230 to 250 grams in the direction of B as shown in Figure 71.

2. Adjust the magnet yoke mounting screws (Figure 71) for a clearance of .032" to .036" between the armature and the yoke at the operating end of the armature.

3. Position the magnet yoke firmly against the support bracket and check associated adjustments.

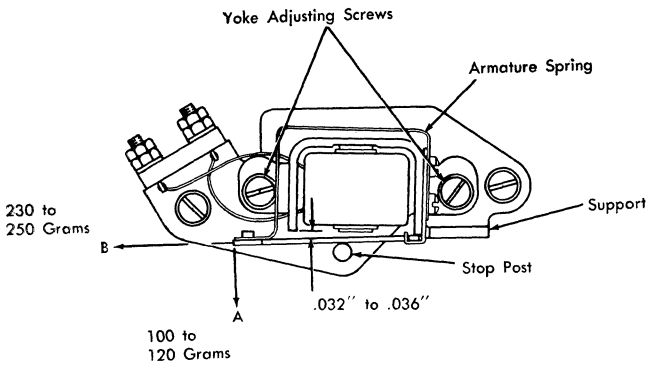


Figure 71. Feed Clutch Magnet Adjustment

4. Position the card feed magnet unit so that, with the armature normal and the card feed latch fully into the notch in the clutch latch disc, there will be a clearance of .012" to .018" from the card feed dog to the CF ratchet (Figure 72).

5. With the CF magnet armature attracted, the armature should clear the CF dog by .010" to .014". Adjust the magnet unit to obtain this clearance.

Card Feed Unit Adjustment (Figure 73)

1. With the card feed clutch latched up and the card feed index at zero, the spot mark on the card feed cam shaft bevel gear should line up with the spot mark on the card pusher cam shaft bevel gear.

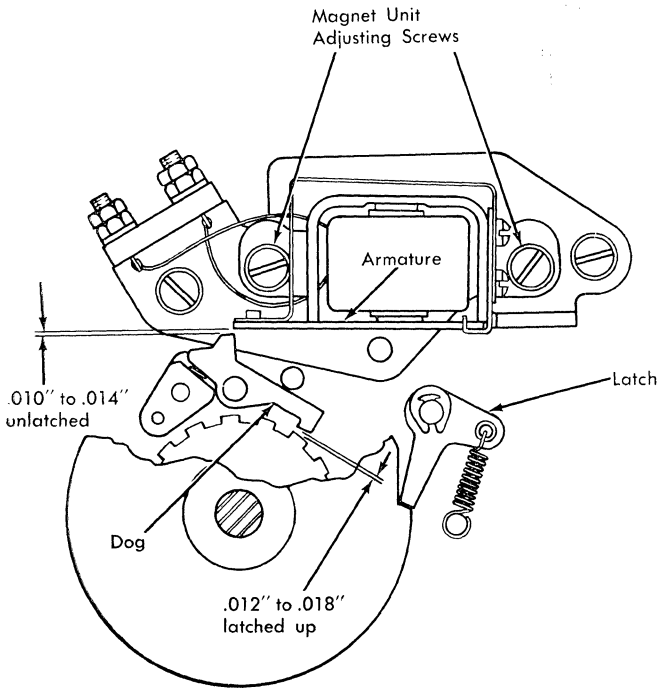


Figure 72. Feed Clutch Adjustment

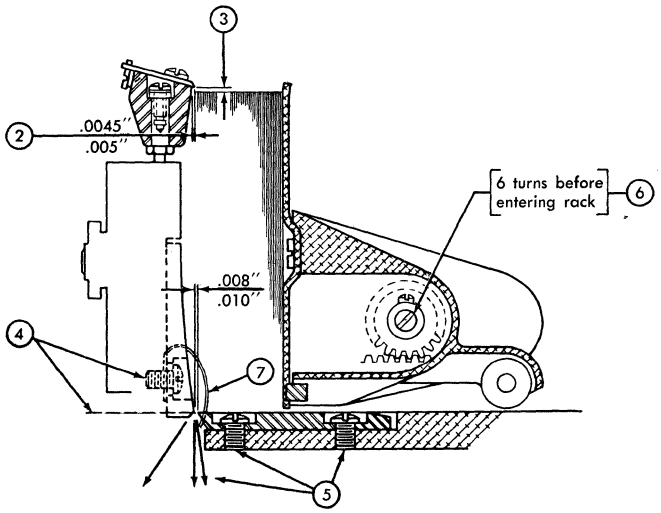


Figure 73. Card Feed Unit Adjustment

2. Adjust the feed knives for a projection of .004" to .0045" over the knife block face with the GO - NO GO gauge. Make sure the knife projection is even.

3. The feed knives extend about ⅛" above the cards in the hopper to insure that there is no card movement when the knives are deflected on register cycles. (See *Knife Block Adjustment* for final setting.)

4. Adjust the throat block so that the crown is in direct line with the top edge of the throat knife.

5. Adjust the throat knife for an opening of .008" to .010". If the throat block is properly adjusted, an .008" gauge should pass freely in the three directions indicated, but a .010" gauge will not.

6. The card feed pusher plate should have 5 or 6 turns to its spring shaft when inserted from the rear of the hopper.

7. The magazine springs should just touch the feed bed. Adjust by shaping.

Latch Magnet Adjustment (Figure 74)

1. With the contacts properly aligned against straight supports, turn the armature backstop screw up until there is a $\frac{1}{32}$" rise from the contacts to their supports.

2. With a .010" gauge between the latch armature and magnet core, position the magnet yoke so that the lower yoke strikes the armature and tighten the screws.

3. Back off the backstop screw two full turns. This will provide approximately $\frac{3}{64}$" from a center line over the magnet yokes to the operating hook of the armature.

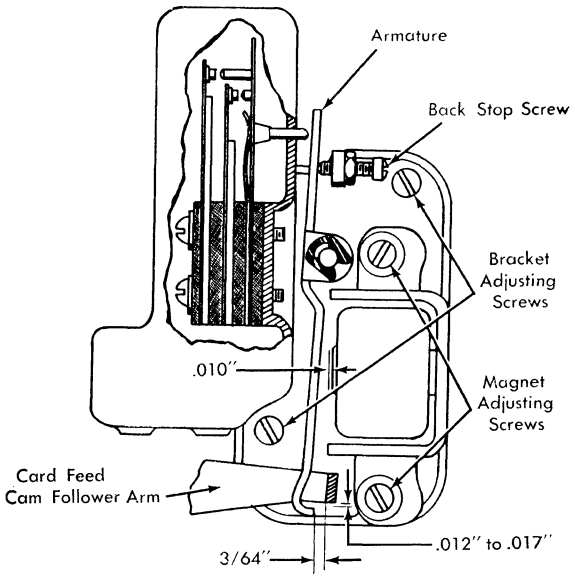


Figure 74. Latch Magnet Adjustment

4. The assembly should be positioned to provide $\frac{3}{64}$" (7 IBM cards) from the latch armature to the ear on the CF cam follower arm.

5. There should be a clearance of .012" to .017" from the cam follower arm to the armature tip when the latch magnet is energized.

Feed Knife Block Adjustment (Figure 73)

The feed knife blocks are to be raised so that with the card feed latch armature engaged with the card feed cam follower arm, there will be a clearance of .012" to .017" from the feed knife to the top of the cards in the hopper. Check for even adjustment on both blocks. Lock the setscrews.

Card Feed Pressure Roll Springs Adjustment

Check for even drag on one card inserted endwise at either side. Rollers should be free of binds, and the two flat type springs should be straight when removed from the machine.

Card Feed Circuit Breaker Adjustment (Figure 75)

1. Replace badly pitted or worn points.
2. Check for a worn operating arm roller.
3. Align points so that the sides and faces of the contacts are parallel.
4. Adjust stationary contact for an air gap of .020" to .025" on the high dwell of cam.
5. With a test light across the points, turn machine over by hand; block the CF clutch unlatched and time

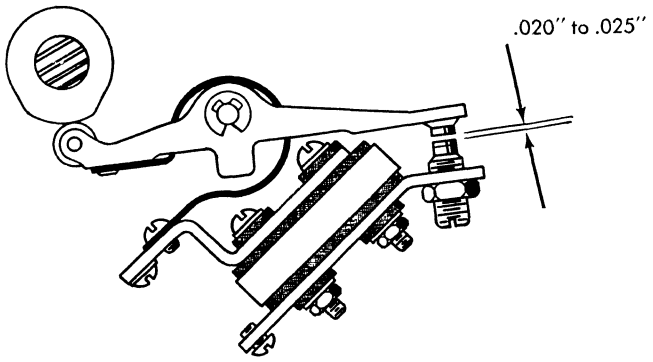


Figure 75. Card Feed Circuit Breaker Adjustment

the CB's to the CF index. The make timings are important and the break timings are ±5°.

To shift a cam loosen the setscrews. After adjustment be careful not to tighten setscrews too tightly because the thin walls of the cams will break.

PUNCH DRIVE UNIT

Punch Clutch Magnet Adjustment (Figure 76)

1. Form the armature spring to obtain a tension of 140 to 160 grams away from the magnet core when it is measured at the operating end of the armature.
2. Shape or adjust the armature spring to exert a force of 75 to 150 grams toward the armature pivot.
3. Adjust the rubber mounted armature stop for an air gap of .006" to .008" from the armature to the outer yoke when the armature is attracted.

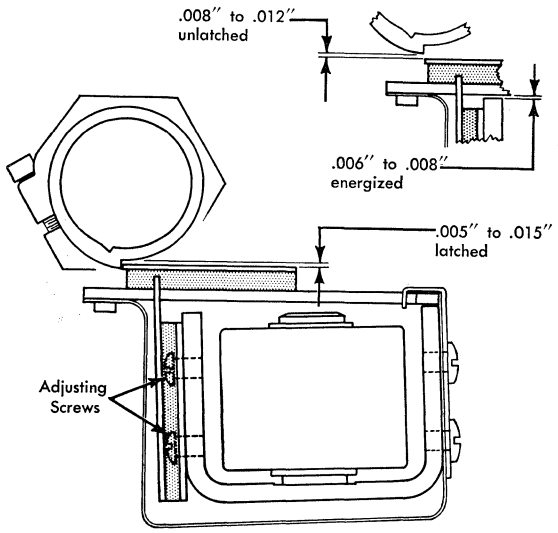


Figure 76. Punch Clutch Magnet Adjustment

4. Position the magnet assembly against its support bracket and use this as a pivot for the next adjustment.

5. Position the magnet assembly to clear the step on the clutch sleeve by .008″ to .012″ when energized. If all the above adjustments are made correctly there should be a clearance of .005″ to .015″ from the armature to the sleeve when the armature is latched on the sleeve.

Punch Index Pointer Adjustment

With the punch clutch detent back against the punch clutch latch, set the punch index pointer to 345° ±2°. Check to be certain that the pointer clears the index periphery.

Punch Clutch Spring and Collar Adjustment

1. With the spring collar sufficiently loose to permit movement of the punch shaft within it, turn the spring clamping collar counterclockwise until the step on the sleeve latches on the armature and the clutch spring unwinds fully in the sleeve.

2. Still holding the spring unwound, turn the index over until the clutch detent overtravels its latch by approximately $\frac{1}{32}$″. Lock the collar screw. When this adjustment is made correctly and if the clutch is turned over by hand, as the sleeve step engages the armature, the detent will have about $\frac{3}{16}$″ travel remaining before the latch will drop in. When turned over by the punch index, the index should not overtravel the latching point by more than 5°.

Removal of a Punch, Type 24

1. Tilt the punch bed to the vertical plane and remove the three screws holding the punch extension lower guide plate. Slide the plate off its guide pins and punch extensions (Figure 77).

2. Any punch is accessible by lifting the extension over the associated punch operating arm and pulling straight out.

When replacing each punch assembly check to see that the retaining pin head is on the same side as the

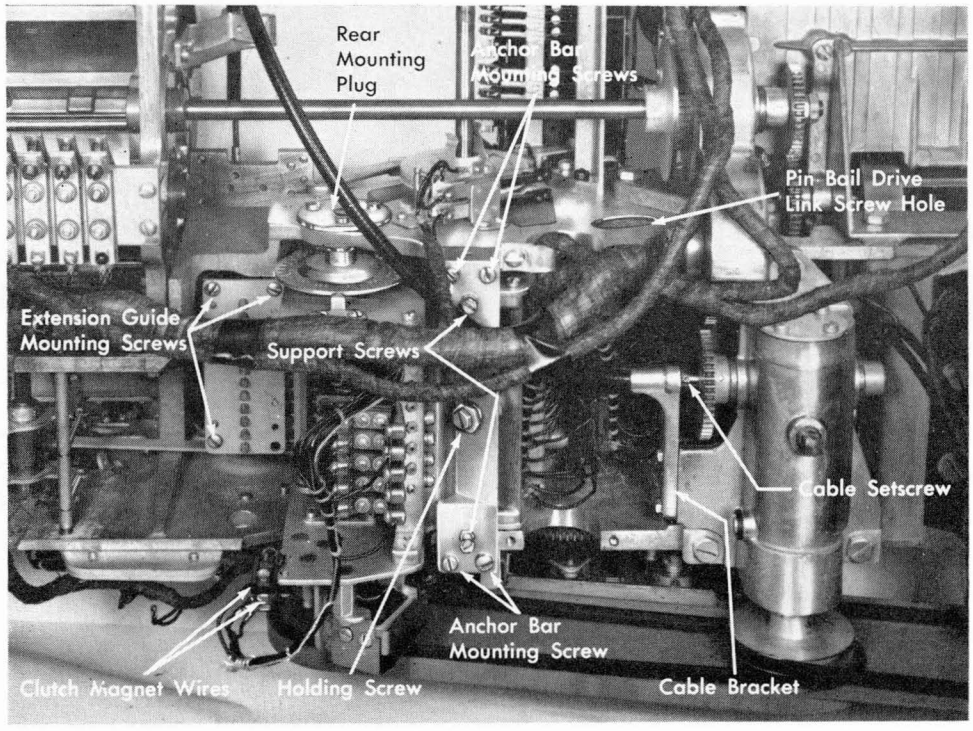


Figure 77. Punch Bed—Bottom View

pin retaining plate and the high point of the punch is toward the front of the machine.

Removal of the Punch Drive Unit, Type 24 (Figure 77)

The punch drive unit can be removed as follows:

1. Remove the rear cover and lift off the top cover.
2. Tilt the bed backwards and remove the belt guard and punch drive belt.
3. With the punch bed pivoted forward, loosen the setscrew in the reduction housing gear hub and pull out the flexible drive shaft. Place the shaft in such a manner that it will not be in the way.
4. Remove the wires from the following:
   a. Punch clutch magnet.
   b. Punch circuit breakers.
   c. Slip connectors to the interposer magnets.
5. Tilt the bed back and remove the mounting plug located above the punch clutch.
6. Restore the bed to the vertical position and remove the rear mounting plug.
7. Remove the two screws in the sensing bail drive link.
8. Remove the holding screw in the punch unit adjusting screw. Be sure the lock nut is tightened so it will not be necessary to readjust the punch travel.
9. Remove the four screws holding the anchor bar to the base.
10. It should now be possible to pivot the punch drive unit clockwise to slide it out of the base and the punch extensions.

To assemble, reverse the above procedure. It is easy to re-engage the punch operating arms with the punch extensions if all the punch extensions are lowered against the bottom guide plate.

Removal of the Bail Drive Link

With the punch drive unit out of the machine as described above, proceed as follows:

1. Unhook the knockoff bail arm spring.
2. Remove the four screws holding the interposer magnet unit in the side frames.
3. Pull the clip off the link guide stud.
4. Unhook the drive link spring and the link assembly is free.

When replacing these sub-assemblies, remake adjustments 1 and 3 under *Punch Interposer Magnet Unit Adjustment* and *Knockoff Bail Adjustment.* Grease the drive link at its stud.

Removal of a Punch Circuit Breaker Cam

With the punch drive unit out of the machine proceed as follows:

1. Drive the taper pin out of the punch index and remove same.
2. Unhook the knockoff bail arm spring.
3. Drive the taper pins out of the two mechanical cams.
4. Loosen the setscrews in all the circuit breaker cams.
5. Slide the punch shaft toward the punch clutch end until the rear end of the shaft is free of the rear bearing, and slip off the desired cam. It should be possible to pass the punch clutch armature with the adjusting collar but if it is not, shift the clutch magnet assembly slightly.

Removal of the Die and Stripper, Type 24 (Figure 78)

If the punch drive unit is in the machine, the die and stripper can be removed as follows:

1. Remove all the punches from the assembly as described above keeping them in their original order by inserting them into a prepunched card.
2. Pull the key top off the back space key.
3. Remove the chip tube by taking out its two screws.

CAUTION: When this assembly is raised, do not lose the pressure roller and spring as they are free to fall out when the tube is raised.

4. Loosen the clamp on the flexible cable and swing the assembly clear.
5. Lift out the release pin from the die.
6. Remove the front pressure rail covers at the punch and read stations.
7. Remove both read station pressure rails.
8. Pull the two dowels from the top card rail in the read station.
9. Remove the 2nd and 4th screws (left to right) from the top card rail.
10. Back off a turn or two on the three remaining screws in the top card rail.
11. Unscrew the black flat headed screw in the read station bed plate and slide the plate out to the right.
12. Remove the space gearing cover.
13. Back out the two die retaining screws and lift out the die and stripper assembly.

When replacing these parts, do not drive the two top rail taper pins in. Insert them by hand and a light

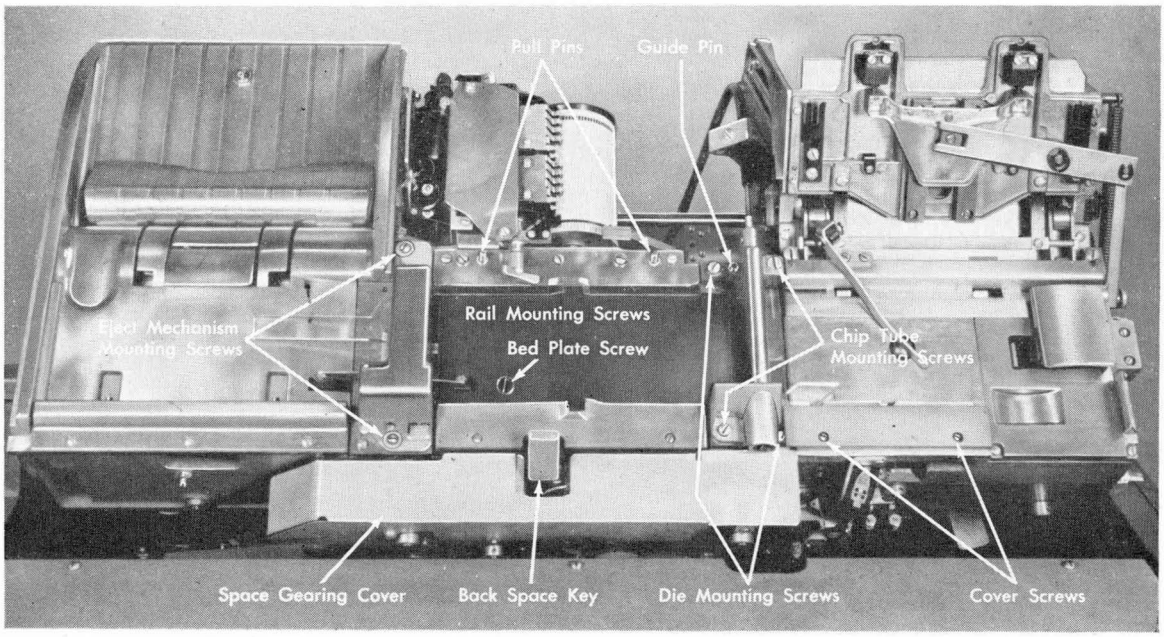


Figure 78. Punch Bed—Top View

tap with the screwdriver handle should suffice. The two pull pins should be installed before any screws are tightened in the bed plate.

It is not advisable to separate the die and stripper unnecessarily. Clear all card chips away from these assemblies when replacing them on the machine.

Punch Operating Arm Guide Comb Adjustment (Figure 79)

This adjustment can only be made with the punch drive unit assembly removed from the machine.

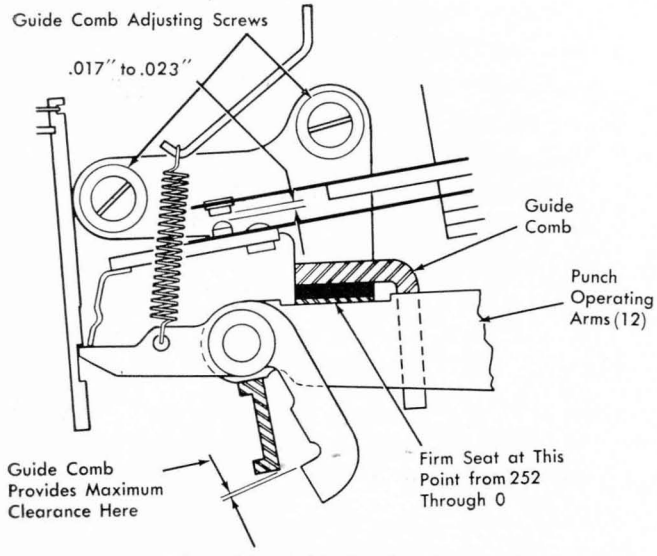


Figure 79. Guide Comb Adjustment

1. With the punch bail at its high point of travel (between 252° and 0°), position the guide comb vertically to give the punch operating arms a firm seat with no vertical play. This adjustment is made against the pull of all the punch operating interposer springs.

2. Check the above adjustment by placing hand pressure against the operating ends of the punch operating arms in such a direction as to take up all play to the guide comb. With this pressure, it should be possible to trip all interposer magnet armatures, and the punch operating interposers should latch on the punch bail.

Punch Interposer Magnet Unit Adjustment (Figure 80)

This adjustment can only be made with the punch drive unit removed from the machine.

1. Position the interposer magnet assembly so that, if all armatures are tripped, their punch operating interposers will start to restore in the notch of the armatures at 90° and will all be restored in the notches at 96° of the punch index.

2. Position the magnet unit horizontally to provide .025" to .030" unlatching clearance from armatures to punch operating interposers. Check at either end of unit for even gap. Adjust by loosening two screws in each side frame. This adjustment must be even across the entire unit because the restoring bail should strike squarely across the unit.

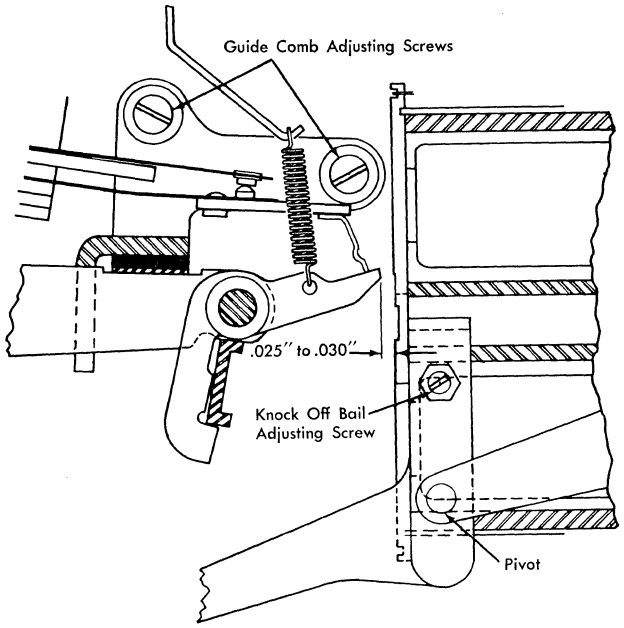


Figure 80. Punch Interposer Magnet Unit Adjustment

Armature Knockoff Bail Adjustment (Figure 80)

By means of the eccentric screw and lock nut accessible through the inspection hole in the rear plate, adjust the knockoff bail to strike on attracted armature between 13° and 20° of the punch index. Check at both ends of the bail.

Interposer Bail Contact Adjustment (Figure 79)

1. The contact air gap should be .017" to .023". To obtain this adjustment position the contact mounting bracket.

2. Adjust the operating strap so that a force of 20 to 25 grams is required at the extreme end to just close the contact points.

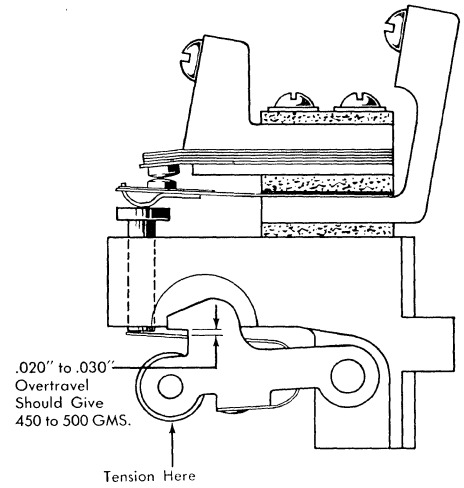


Figure 82. Punch Circuit Breaker Adjustment

Punch Circuit Breaker Adjustment

1. It should require 100 to 150 grams to move the operating point to contact the stationary point when measured at the end of the operating strap.

2. The contact air gap should be .027" to .032" when the plunger is resting against the frame (Figure 81). Add or remove shims to obtain this adjustment.

3. When measured at the roller, it should require 450 to 500 grams to close the contacts with .020" to .030" overtravel as shown in Figure 82.

4. With the circuit breaker assembly attached to the mounting bar by the holding screw, turn in on the adjustment screw to obtain a contact air gap of .017" to .022" when in the low dwell of the cam (Figure 83).

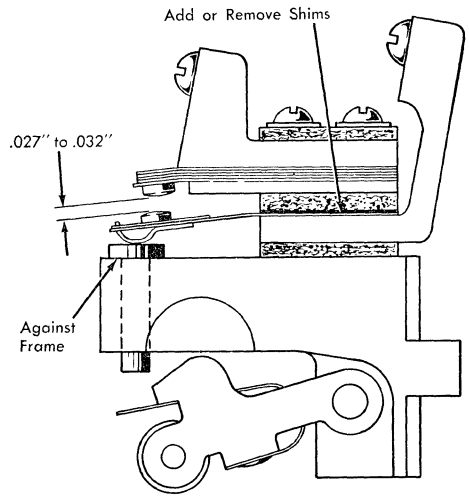


Figure 81. Punch Circuit Breaker Adjustment

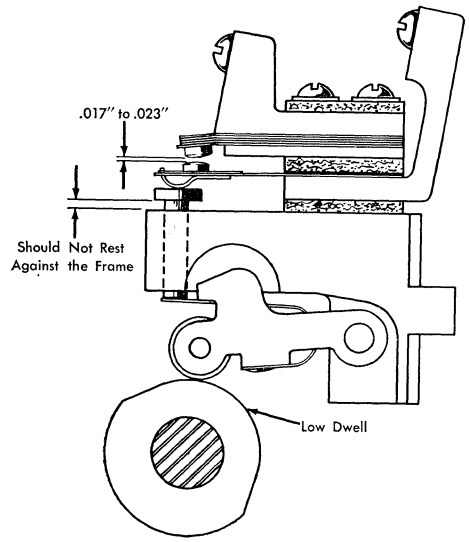


Figure 83. Punch Circuit Breaker Adjustment

5. When positioning the dilecto cams, be careful not to tighten the cam holding screws too severely as their walls will crack.

Punch Travel Adjustment (Figure 84)

The proper punch travel is essential for several reasons: 1. A clean punched hole is essential. 2. Too much travel causes excessive punch wear. 3. Chips must not be driven free of the die. Under normal conditions, 3 to 4 chips should remain locked in the die.

Punch travel should be set by trial as follows:

1. Back off the two support screws in the punch drive unit anchor bar. These screws must be backed off before attempting adjustment.
2. Loosen the holding screw which causes the punch drive unit to follow the adjusting screw in the anchor bar.
3. Loosen the pin bail drive link screws.
4. Turn in on the adjusting screw until the lowest punch fails to punch clear through the card. This can cause the card to hang up. Free the card by holding down the space bar, operate the release lever to remove the card buckle, and multiple punch the column until the card is free.
5. In steps of 1/6 turn, back off the adjusting screw. Be sure to tighten the holding screw after each operation in steps 3 and 4 to insure that the drive unit follows the adjusting screw. This step is continued until clean holes are punched 9 through 12.
6. When a point is reached where all holes punch clean, back off the adjusting screw 1/2 turn additional and bring up the lock nut and holding screw. This should result in .008" to .010" travel of the heel of the punch into the die. The adjustment should be checked with duplication of a card that is triple punched 12, 11, 0 in the odd-numbered columns and 7, 8, and 9 in the even-numbered columns. If additional travel is required, make them in 1/6 turn steps.
7. Turn in the two support screws to just touch the punch drive unit. Additional travel of these screws will distort the punch drive unit or bend the anchor bar.
8. Readjust the sensing pin bail drive link.

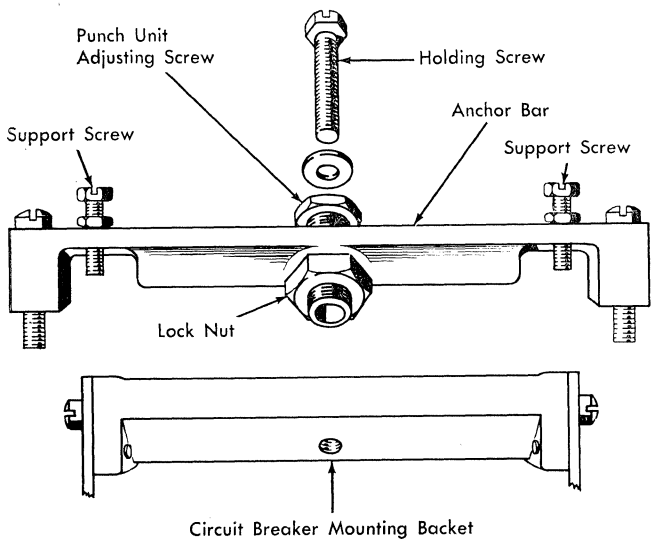


Figure 84. Punch Travel Adjustment

Removal of the Serrated Feed Roll, Read Station

To replace a serrated feed roll, it should not be removed from its shaft. Assembled to a tolerance of .0005", the wheels are pressed on the shaft before being pinned. Even though it may be possible to separate the roll from the unit in the machine, there is no assurance that the new assembly can be separated. It is recommended that the following procedure be used:

1. Remove the pin sensing unit. See page 36.
2. Drive the pin out of the space gear which is mounted on the feed roll shaft—not out of the feed wheel.
3. Remove the three collars, and the space gearing bracket.
4. Remove the friction drive.

The entire mechanism including the space gear should slide off the shaft.

5. Pull the spring clip off the eject operating link stud at the rear station so that the release pin arm can be turned up.
6. Tap lightly on the feed wheel hub toward the front of the machine to force the bearings out of the bed casting. This will leave a large enough hole in the base casting to slip the shaft and feed roll inside the base casting.

To install a new unit, reverse this procedure. After the space gearing bracket is replaced on the machine, be certain to pull the shafts containing collars toward the bracket before locking. These bearings determine the operating position of their associated gears and feed wheels.

Removal of the Serrated Feed Roll, Punch Station

The same condition is true of the punch feed roll as the read feed roll described above in regard to separating the feed wheel and shaft. Proceed as follows:

1. Remove the punch drive unit (page 41).
2. Remove the die and stripper (page 41).
3. Remove the pins from the escape wheel and the space gear.
4. Remove the collar from the escape wheel shaft. Slide the shaft toward the rear of the machine and slip off the escape wheel and gear.
5. Slide the shaft back far enough to insert, by hand, one of the taper pins. Use this pin to force the ball bearing out of the front casting. Pull the pin and bearing free of the shaft and slip the shaft through to the inside base and out the top.

Upon replacing these assemblies, pull the escape wheel shaft toward the bearing in the space gearing bracket and lock the collar. There should be little or no end play to the escape wheel shaft.

LUBRICATION SPECIFICATIONS TYPE 24 and 26 PUNCHES

General

Do not oil or grease the escape wheel.

1. Grease the flexible shaft with IBM 17.
2. The friction drive discs should be saturated with IBM 6 by soaking them at least 24 hours before using. Do not add oil to them unless a chattering condition occurs or the friction becomes too great for the escape armature to pull out.
3. Use IBM 6 sparingly on the escape gearing.
4. Use IBM 22 on the stacker gears and cams. Wipe off excess from the sides of the gears.
5. The reduction housing should be filled with the punch bed tilted to the vertical position. Use IBM 22 (Shell, Retinax T) and fill to the filler plug. Each machine holds about 80 cc. of lubricant.
6. Grease the pivot ends of the escape magnet armature and the feed clutch magnet armature with IBM 22.
7. The star wheels should be free on their shafts. Use IBM No. 6 sparingly on the star wheel pivots.

Keyboards

1. Saturate the felt key bumpers with IBM 6. The bumpers should not be dripping with oil.
2. Apply IBM 6 lightly to all friction surfaces not covered by other specifications.

NOTE: Do not oil or grease the ends of the pull bars or the interlock discs. Oil causes the discs to bind up the keyboard.

3. Apply IBM 17 generously to the top edge of the restoring bail.
4. Apply IBM 17 to both sides of the pull bars at the springs and "L" guides.

Pin Sensing Unit

1. Use IBM 9 on the operating stud of the pin bail arm.
2. Oil the felt wicks for the pin bail shaft from the top of the machine with IBM 8. This replenishes the oil to the porous bronze bushings which receive heavy duty.

Card Feed Unit

1. Use a light film of IBM 8 on all open gearing except the bevel gears which should be lubricated with IBM 22. Wipe off the excess oil to prevent its saturation into nearby cables.
2. Use IBM 8 on porous bronze bushings and powdered metal parts. This lubricant is desirable because other types will oxidize them and prevent penetration.
3. Use IBM 8 on spring ends.
4. Grease the card feed pressure roll bearings with IBM 22.
5. Use IBM 8 on the card feed circuit breaker pivots. No additional lubrication is needed on the ball bearing cam follower rollers.
6. Use IBM 6 sparingly on all moving parts of the registration and eject mechanism.
7. Use IBM 6 on the punch pressure roll shaft and arm pivot.

Punch Drive Unit

1. Grease the punch clutch spring (grease fitting on the front end of the punch shaft) with IBM 22. Avoid excessive greasing.
2. Grease the knockoff cam and follower with IBM 17.
3. Grease the pin bail drive link and guide stud in the rear frame with IBM 17.
4. Oil the felt spacers between the punch operating arms with IBM 6. Excessive oiling at this point will drip oil on the punch circuit breakers causing fouling thereof.
5. Use IBM 6 on the punch extensions at the retaining pins, lower guide plate and punch operating arms.
6. Grease the pivot end of the punch clutch armature with IBM 17.

(See page 76 for additional information)

CIRCUIT DESCRIPTION

GENERAL INFORMATION

THE following data pertain to both Type 24 and Type 26 machine diagrams unless otherwise designated.

Sections 1 and 2 supply the power chassis, power connections, drive motor and voltage options. Sections 3 and 4 contain both numerical and combination keyboards, sensing pin contacts and interposer magnets. Sections 5 and 6 show most of the machine relays, the tubes that energize them and the control circuits to their grids. Sections 7 and 8 contain reference data such as relay location charts, chassis location charts, special keyboard contact location and the electrical timing charts. Sections 9 and 10 are the mechanical timing charts.

In sections 7 and 8, the non-critical end of the electrical cams indicate the tolerance permissible. For example, CF3 is listed: make 70° break 150°±5. This indicates that make at 70°, should be as close as possible and the break could be as early as 145° or as late as 155°. It should be noted that the punch cams are held to closer tolerance than the card feed cams. The latching time of the card feed clutch is at zero and the punch clutch at 345°. Another point to remember while discussing circuits is the comparable speeds of the two clutches. It will be seen that punching starts and can even complete the first auto-duplicate or auto-skip field before the card feed latches up since the card feed operates at 60 RPM and the punch shaft at 20 times that rate or 1200 RPM.

The polarity traps (selenium rectifiers) will carry only 5 ma. current. This is far below the load drawn by a test light. Serious damage to the rectifier will result unless they are shorted out while circuit checking with a trouble light.

Power Supplies

From Figure 85 it may be seen that the fusetron protects the filament transformer and the drive motor. The full wave selenium rectifier is protected by 2 each 2-ampere fuses. All fuses are mounted behind the chip box and are accessible by removing the chip box.

Because of the large capacitor (200 MFD) across the D.C. output, plus a high resistance bleeder, an average voltage taken across the rectifier when the machine is in operation will range from 130 to 160

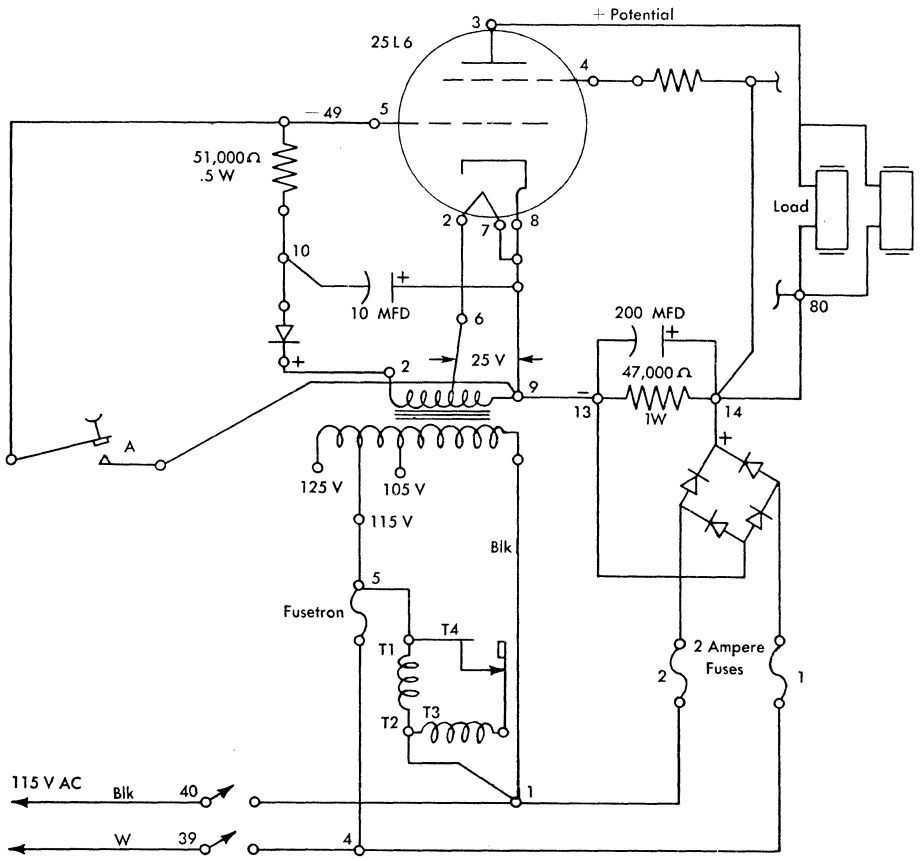


Figure 85. Schematic of Power Connections

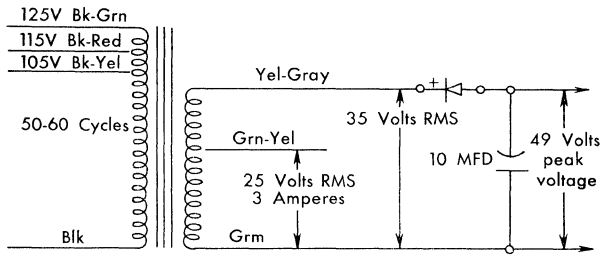


Figure 86. Filament Transformer

volts. This voltage does not detract from machine performance but rather is given a faster pickup to relays and clutch magnets.

The grid bias is obtained as shown in Figure 86. Since there is almost no grid current, the 10 MFD capacitor will remain charged to peak voltage which is about 1.4 X RMS voltage read by the voltmeter at the transformer.

Figure 85 is an actual schematic of the voltage application to enable you to more clearly visualize tube and power connections.

The variable transformer taps are provided to obtain proper filament voltage from the available A.C. Supply.

Glossary of Terms and Abbreviations

R24-6	The first digit indicates relay number. The digit following the dash indicates the point of a wire contact relay.
N/C	Normally closed point.
N/O	Normally open point.
O/P	Operating point.
A.C.	Alternating current.
D.C.	Direct current.
R	Relay.
P	Pick (coil).
H	Hold (coil).
PL	Plate terminal on tube chassis.
GR	Grid terminal (control grid), on tube chassis.
SCR	Screen grid terminal on tube chassis.
ms.	Millisecond.
CF	Card feed.
P1	The P in this case when followed by a digit indicates punch cam.
28.35	Grams = 1 ounce.

Basic Tube Operation

Before proceeding with tracing circuits, several elementary principles will be reviewed. The following

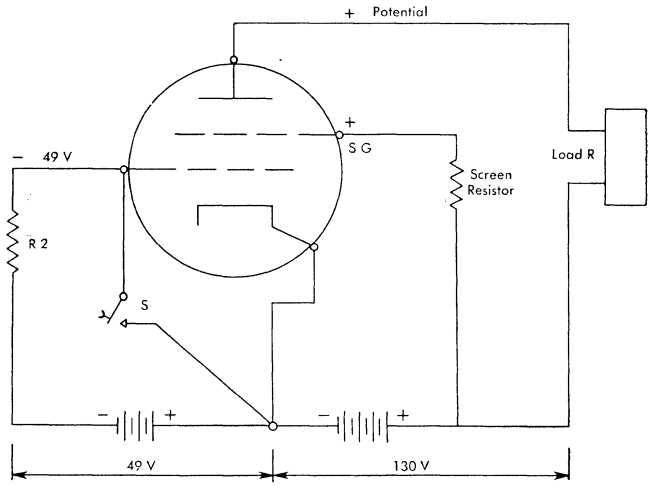


Figure 87. Normal Tube Operation

discussion will apply theoretically to the application of the 25L6 beam power tetrode used in this machine.

In Figure 87 it is assumed that the tube will cut off at −20 volts bias; therefore, no current flows in the anode circuit since the grid is held at −49 volts bias. With no current flowing through load R, there will be no potential drop across it, and point A will be at the same potential as the rectifier, i.e. + 130V. It is well to note at this time that all voltages are stated with reference to the cathode voltage as zero.

The 25L6 tube is designed so that at +130V on the plate and without a plus voltage on the screen grid, even though the control grid is at cathode potential, the tube will not conduct. It will also be found that varying the plus voltage on the screen grid will cause a variation in the voltage drop across the tube.

Now place +130V on the screen grid at SG in Figure 87 through resistor R1. By closing switch S, the control grid is placed at cathode potential. Conduction will take place through the tube and load resistor R. Assume the desired current through load R is 40 milliamperes and its resistance is 2000 ohms. The moment the tube starts to conduct, also assume the voltage drop across load R to be 100 volts and across the tube 30 volts. This places a high starting voltage across load R. The moment the tube conducts electrons traveling at high velocity, splash off the anode and gather on the screen grid. The electrons will flow through resistor R1 causing a voltage drop across it. This will make the screen grid more negative and cause it to suppress the electron flow through the tube and an increase in the voltage drop across the tube. Assuming the voltage drop across the tube to rise to

50 volts, there will be a decrease in the drop across load R. 130V–50V=80V across R which in turn supplies the desired current.

By substituting load R with a relay coil, a sample of the usage of the tube in this machine is demonstrated. The voltage across the relay under actual machine application is approximately 80 volts. This may seem excessive across a 40 volt relay but since it is of very short duration, no damage is incurred.

In applications where there is a possibility that the machine may be idle for extended periods, when a tube energized relay is picked up, the screen grid resistor value is increased to further reduce the expressed voltage across that relay. This accounts for the variations of screen grid resistor values.

Test voltage readings taken across the various wire contact relays (energized) when the machine is first installed can aid the Customer Engineer in locating marginal failures which occur due to aging of the circuit components. Caution must be exercised to protect the meter used if connections are made before the relay is energized because the initial voltage surge may be above scale for that desired when taking this reading.

When a circuit is completed from zero potential to any control grid, it will be understood that the relay or clutch magnet in the plate circuit of the associated tube energizes.

A special application is used for tube 9 in the Type 26 Printing Card Punch. An example is shown schematically in Figure 88. Assume that switch S is closed causing the tube to conduct. If switch S1 is closed, grid SG will go to cathode potential and block the tube. The print suppression magnet in its plate circuit will become de-energized. This gives two means of controlling tube 9. While the field definition 12

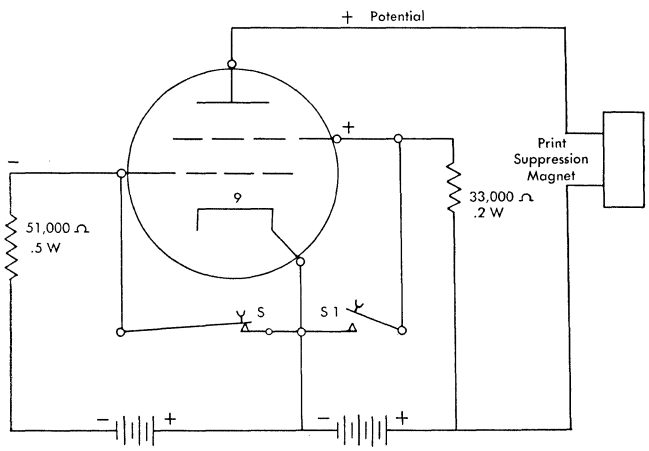


Figure 88. Zero Printing Schematic

contacts are holding the control grid at cathode potential and, with the print suppression magnet energized under normal operation, zero printing to the left of the first significant digit is operative by programming 2's and and blocking tube 9 over the desired columns.

The circuits are designed and the tubes controlled in a manner to assure positive operation and overcome chance or unavoidable difference between tubes of the same type. For this purpose, a tube is held non-conductive, when so required, by a potential on one of its grids which is considerably below cutoff. The grid resistor has a high value to safeguard the power source. When a circuit is completed to a grid, its respective grid resistor is across the power supply.

Similarity of Circuits

Because of the similarity of basic circuits in these machines, this circuit analysis applies to either wiring diagram 228001A (Type 24) or 228005A (Type 26). Where there is a minor variation in tracing point to point, attention is called to it at that time.

The printing circuits for the Type 26 Printing Card Punch are isolated in a separate section following this description.

Before proceeding with this circuit analysis, three points of reference should be established:

1. Post 76 is connected to all cathodes and the minus D.C. supply. If the cathode voltage is considered as zero in respect to tube circuits, completing a path from this post to a control grid (GR) is assumed to cause the tube to conduct.
2. Post 80 serves in a similar manner to item 1 but for the + potential.
3. Grid numbers correspond to tube numbers, hence grid 3 is the control grid to tube 3.

STARTING THE MACHINE

IN ORDER to render punching operative, it is essential to energize card lever relay 3; until it is picked up, punching, duplicating, and program controls are inoperative.

Card Feed Clutch Magnet

When the feed key is depressed, its latch contact closes to energize the card feed clutch magnet and to feed a card down onto the punch bed. The circuit is: post 76, through the back space switch, card lever relay

3 BU N/C, post 69 (Section 3B), feed key latch contact, one side of the auto-feed switch, post 71 to the CF latch magnet contact, through the card feed clutch magnet and along the common to post 80. Late in the card feed cycle, the card lever contact is closed, but this is after CF3 has made and broken. Therefore, to pick R3 it is necessary to operate the feed key again and cause another card feed cycle.

Card Lever Relay 3 Pickup

At 70° of the second card feed cycle, R3 is energized as follows: post 76, through the back space switch, to R3BU, RIBL, RIBU, CF4, through CF3 (Section 3B), card lever switch, card lever relay 3 pick coil and post 80 picking up R3. At 55° of this cycle, the first card will have been registered in the punching position. Once picked up, R3 will hold for the complete card operation. The hold circuit is: post 76, through program cam contact 2 N/C, R3AL, R3H coil and post 80. Relay 3BU N/O lower closes to make all the 25L6 grid circuits operative including the program card controls. R3BU N/O closes to make the keyboard contacts operative.

Relay 3 drops between cards to render the above mentioned circuits inoperative while feeding takes place.

ESCAPE AND PUNCH CYCLES

Escapement Magnet

Whenever an interposer magnet is energized, the corresponding punch operating interposer unlatches and closes the two interposer bail contacts in parallel. The interposer magnets can be energized from the keyboard when manual punching or from a pin contact when duplicating. When the interposer bail contact closes, grid 3 is driven from its normal bias of –49 volts to cathode or zero potential and tube 3 conducts energizing the escapement magnet. The circuit to the grid is as follows: post 76, through the back space switch, R3BU N/O, to R2BL through the interposer bail contacts, to the escape contact, through R25-4 N/C, R24-3 N/C, R22-3 to grid 3. The circuit to the escape magnet is as follows: post 76, post 13, post 9, cathode to plate to tube 3, through the escape magnet, to the punch clutch magnet common, through P1, to post 80.

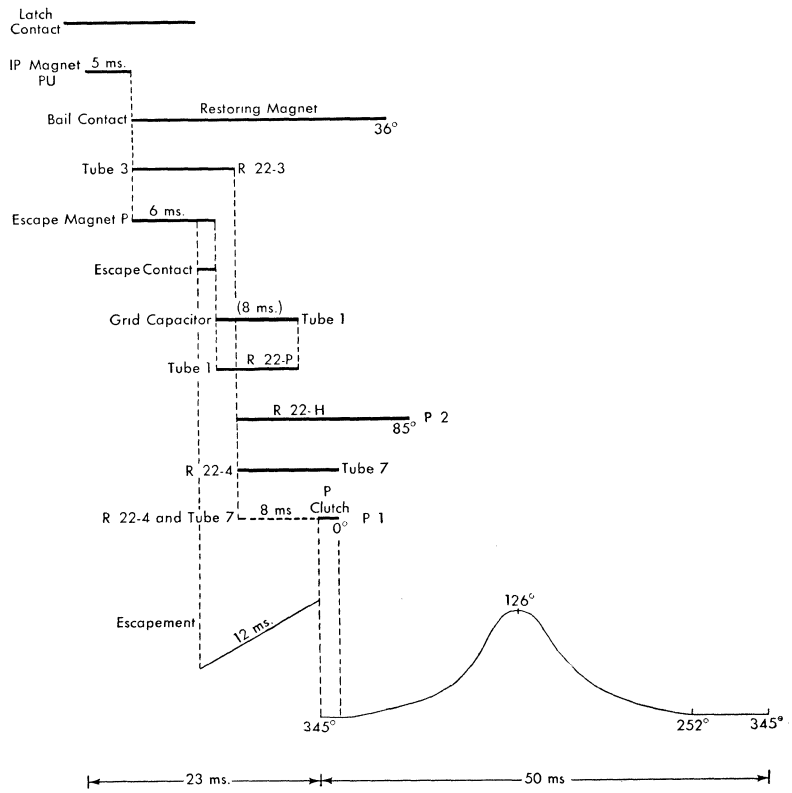


Figure 89. Single Manual Punch Cycle

Interlock Relay 22

When the escapement armature is attracted completely, the escapement armature contact closes driving grid 1 to zero and energizes interlock relay 22 through tube 1. The circuit to grid 1 is the same to the interposer contacts but through the escape armature contact to grid 1. Relay 22 has a separate hold circuit as follows: post 76, through the back space switch R3BU N/O, to R2BL, R22-4, R21-2, R24-1, R30-1, P4, through P2, R22-1 N/O, resistor 7, R22H coil to post 80. Thus, relay 22 will hold until 85° of the punch cycle when P2 breaks. Relay 22-3 breaks allowing grid 3 to return to –49 volts. This blocks tube 3 and allows the escapement armature to fall back into the following tooth of the escapement wheel, and impulses the punch clutch magnet.

Punch Clutch

Relay 22-4 N/O drives grid 7 to zero energizing the punch clutch magnet. Thus, relay 22 terminates the escapement allowing only a single column escapement and also energizes the punch clutch magnet to cause a punch cycle. See Figure 89 for the sequence chart of this operation.

Time Elements

Although the escapement armature contact is made only momentarily, R22P coil gets approximately an 8 ms. impulse because of the .25 MFD capacitor from grid to cathode of tube 1. The time taken to charge this capacitor delays the time when grid 1 reaches cut-off bias for tube 1. The 47 ohm resistor in series with this capacitor protects the escapement armature contacts when it makes the first time because it limits or retards the discharge of the capacitor.

To show relationship between the electrical function and mechanical functions, time in milliseconds (ms.) will be used frequently. When auto-duplicating is being performed, the punch clutch never latches up between columns, therefore, the punch shaft makes 20 (or 17 on the Type 26) revolutions per second. Breaking down this table further, the punch index travels 7.2° in 1 ms. on the Type 24 Card Punch.

The escapement wheel teeth move past a given point at the rate of 12 ms. per tooth and one tooth corresponds to 1 card column. It takes approximately 6 ms. to move the escape armature out of a tooth. At the end of the armature travel its contact closes and energizes R22 (Figure 90).

When R22 picks up and breaks the circuit to grid 3, the escape magnet is de-energized and its armature drops back on the escape wheel before the middle of the next tooth. Therefore, when the armature is held attracted for a skip, the card progresses at 12 ms. per column until stopped again by the escape magnet armature. Capacitor C5 is placed around the interposer bail contacts to insure conduction in the event the contacts should bounce.

PROGRAM CARD CONTROL

Automatic Skipping

Automatic skipping is caused by punching and X in the highest order column of an auto-skip field followed by a row of 12's in every remaining column of the field.

Skip Relay 25

When the 11 star wheel drops into the 11 hole in the program card, skip R25 picks up as follows: post 76 through the back space switch, R3BU N/O, post 42, to program control lever switch 2, to the common of the program contacts, through the 11 program contact now closed, post 73, auto-skip, auto-dup. switch (left) ON, post 74, R24-2, to R25-1, R1AU, through post 92, rectifier 2, post 98 to grid 4 causing R25 to become energized.

Escape Magnet

As soon as R25 picks up, a circuit to the escape magnet is completed as follows: post 76 through the

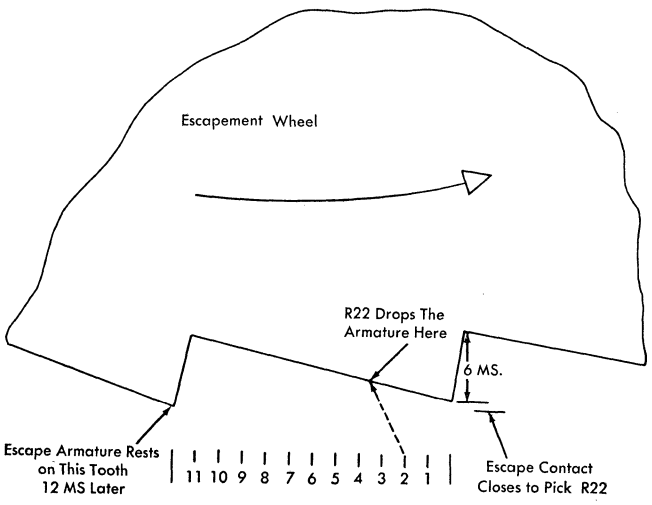


Figure 90. Escapement Timing Chart

back space switch, R3BU N/O, post 42, to program control lever switch 2, the common of the program contacts, through program contact 11, post 73, auto-skip, auto-dup. switch (left) ON, post 74, R24-2, to R25-1 RIAU, through post 92, rectifier 2, to post 98, through R25-4 N/O, R24-3 N/C, R22-3 to grid 3 causing the escapement magnet to energize and allowing the card to advance.

Field Definition

When the 11 program contact breaks, the 12 program contact closes maintaining the circuit to grid 4 (R25) and the escape magnet as follows: from the 12 program contact, to R28-2, through R25-1 N/O, to RIAU, through post 92, rectifier 2, post 98 to grid 4, thus holding up skip R25 for the duration of the 12's. The circuit for holding up the escape magnet is as follows: through the 12 program contact, to R28-2, through R25-1 N/O, to RIAU, through post 92, rectifier 2, post 98, R25-4 N/O, R24-3 N/C, R22-3 to grid 3. Since the 12 program contact remains made as long as the star wheel rolls along in a series of holes, skip R25 and the escape magnet will remain energized until the 12 program contact breaks as the star wheel rolls out of the last 12 hole. Thus, automatic skipping is accomplished by attracting the escapement armature and allowing the escape wheel to spin freely at its maximum speed of 12 ms. per column until the end of the field definition 12's in the program card.

Card to Card Skip

In order to skip from column 81 through 88 to column one of the column indicator, a program cam and contact is provided. Program cam contact 1 which makes in column 88½ and breaks in column 88⅙, trips grid 4 causing skip R25 to be energized. This cam contact is in parallel with program contact 11 so that this skip is similar to the automatic skip described above except that the circuit is direct from post 76 to the contact instead of through R3BU N/O because R3 drops out between cards.

Automatic Duplication

Automatic duplication is started by sensing a zero in the highest order column of a field in the program card followed by 12 holes sensed in every remaining column of the field. When the star wheel drops into the zero hole, duplicate 1 relay 28 picks up as follows: post 76, through the back space switch, R3BU N/O, post 42, to program control lever switch 2, program contacts common, through the zero contact, post 75, auto-skip, auto-duplicate switch (right) ON, post 78, R24-4, post 99 and to grid 5 causing duplicate 1 relay 28 to pick up. Escape interlock relay points 22-4 N/C with P4 cam contact in parallel through R28-1 establishes a hold circuit for R28 until after the first escapement starts. (When a program card is not being used, this hold circuit assures that one complete column of duplication will be obtained when the DUP key is depressed momentarily.) When the DUP key is depressed momentarily in the highest order blank column of a manual field, this circuit will hold duplicate 1 relay 28 until after the first escapement starts and the 12 star wheel drops into the first 12 hole, thus setting up a hold circuit for R28 to the end of the field.

Duplicate 2 Relay 2

Because the duplicating (sensing pin) contacts are cam driven from the punch shaft, it is necessary to energize the punch clutch and cause a pin sensing cycle without an escapement to read the first column of a field. This reading only cycle is accomplished by picking up duplicate 2 relay 2 through duplicate 1 relay 28-4 as follows: post 76, through the back space switch, R3BU N/O to R2BL, R22-4, R21-2, R24-1, R30-1 P4 through P2, R22-1 N/C, R27-4, R28-4 duplicate 2 relay 2 and post 80. Relay 2 has its own hold circuit through R2AL and P2 cam contact so that it will hold until 85° of the following cycle.

Relay 2 Read Cycle

Relay 2BL contacts complete a circuit to grid 7 causing the punch clutch magnet to energize and give a pin sensing punch shaft revolution (no preceding escapement this cycle).

Duplicate 3 Relay 27

At 10° of this cycle, duplicate 3 relay 27 picks up as follows: post 76 through the back space switch, R3BU N/O, to R2BL, R22-4, R21-2, R24-1, R30-1 P4, P2, through P3, R2BU, post 17, resistor 4, post 18 duplicate 3 relay 27, H coil and post 80. Once up, duplicate 3 relay 27 will hold through R27-1 in parallel with duplicate 1 relay 28 in the plate circuit of tube 5. R27-2 in series with P5 cam contact completes a circuit from post 76 to the sensing pin contacts so that when the sensing pin contacts read the holes in the master card on this cycle, they will complete a circuit to the interposer magnets.

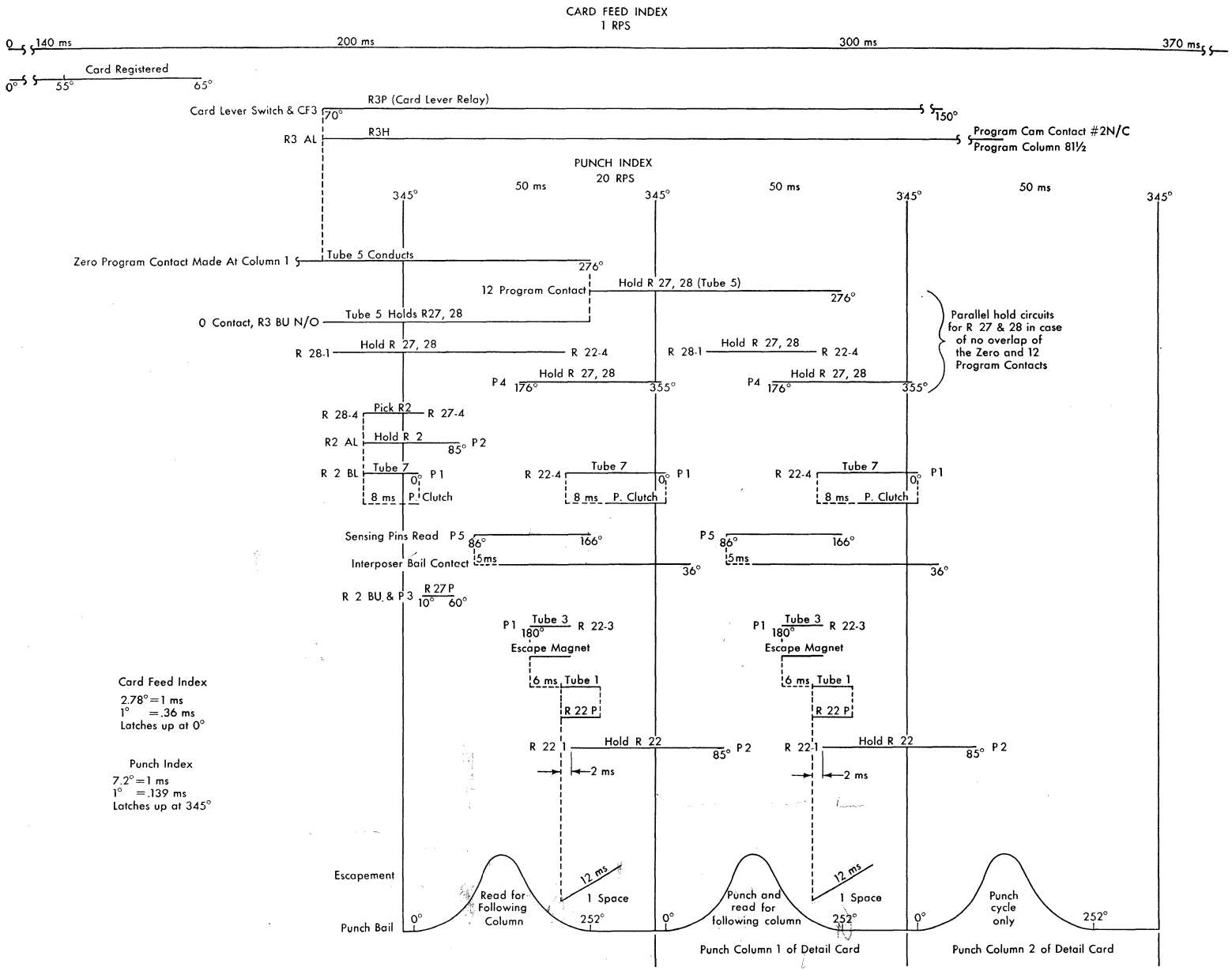


Figure 91. Sequence Chart—Auto-Duplication

Punch Clutch Magnet

Any interposer magnet that is tripped will close the interposer bail contacts and cause an escape and punch cycle as described previously. On this first escapement the 12 program contact makes and the zero contact breaks. The 12 program contact serves as a hold for relays 27 and 28 in the plate circuit of tube 5 for the duration of the definition 12's as follows: post 76, through the back space switch, R3BU N/O, post 42, to program control lever switch (open) through the 12 program contact, R28-2 N/O, R27-5 N/O, R21-3, R25-2, (on the Type 26, through post 93, rectifier 3, post 99; on the Type 24, to R24-4) to grid 5. Thus, the machine will duplicate until the 12 program contact breaks at the end of the field.

Pin Sensing

When auto-duplicating is being performed, pin sensing the following column occurs at the same time the punches are punching the card (Figure 91). This is the reason for having the master card and also the program card one column ahead of the detail card. The speed of auto-duplication is the maximum speed of the punch shaft. During auto-duplication, the punch clutch does not latch up between columns and the escapement falls within the preceding punch cycle.

A study of Figure 91 will clarify this point. Assume that the machine is programmed for auto-duplication in the first two columns of a card. At 55° during the card feed cycle, the card will be registered and at 70° CF3 makes to re-energize card lever relay 3. The program drum is already standing in column one waiting for R3 to pick up. The zero program contact is closed since the drum stopped in column one after the ejection of the last card. The master card standing in column one is also ready for R3 to pick up. It is well to remember that the purpose of relay 2 is to cause a pin sensing punch shaft revolution without an escapement preceding it so that the first column of auto-duplication fields may be read to start the spacing and punching cycles which follow. As was previously stated when R28 is picked up through the zero program contact, R28-4 picks up R2 through the normally closed R27-4. When auto-duplicating is being performed, the only time this condition is possible is at the start when R28 picks up through the zero contact.

Key Duplication—Manual Field—Programmed

The duplicate key performs the same function in a programmed manual field that the zero program contact does in an auto-duplicating field. Relay operation is identical, R28 picks R2 for the read only cycle and R2 picks up R27 to make the sensing pins operative. Once picked up, R28 and R27 hold through the 12 program contact for the duration of the field. (See *Manual Field Control-Duplication.*)

Key Duplication—without Program Card

When not programmed, key duplication is a 100 ms. per column operation. Relay 27-5 N/C breaks the series circuit through the DUP key to grid 5 for each column thereby providing a pin sensing cycle ahead of each escape and punch operation. Doubling the operating time gives more precise control when duplicating, for example, to a column in error.

Card Feed Cam 1

CF1 is in series with the duplicate key to make this key inoperative until 90° of the card feed cycle. In the event that the duplicate key was held down between cards and the first field programmed for an auto-skip, skip R25 and duplicate R28 would be impulsed simultaneously when R3 picked up at 70°. This condition could occur only if the auto feed switch were on so that a card feed cycle would be initiated between program columns 82 and 87.

Alphabetic Field Control

A row of 1's, the alphabetic field designation, must be placed in the program card in any manually punched alphabetic field. Relay 30 points shift the keyboard from numerical to alphabetic. The 1's will cause R30 to be energized through tube 8. If it is desired to duplicate a numerical or an alphabetic field which has blank columns, a row of 1's should be placed in the program card in addition to the auto-duplication control. The 1's picking up R30 will cause the interposer bail contacts to be by-passed by R30-1 and duplicate 3 R27-3 to cause escape and punch cycles for the entire field. Thus, it is unnecessary to pin sense a hole in every column to keep the machine running. In a numerical duplicated field, it is necessary to pin sense a hole in every column to operate the interposer bail contacts to keep the machine running. By not programming 1's, this feature can be used as a blank column check. On machines with the numerical keyboard, the 1 punch is still used to permit spacing over blank columns even though R30 is not used in the machine.

The circuit to by-pass the interposer bail contacts is as follows: post 76, through the back space switch,

R3BU N/O, to post 42, program control lever switch 2, common of the program contacts through the 1 contact to post 43, up the dotted wire for numerical keyboards, through R27-3, to R28-3 through R25-4 N/C, R24-3 N/C, R22-3 to grid 3. This circuit causes grid 3 to be zero biased and the escape magnet, R22, and punch clutch, will energize over columns programmed with 1's.

Manual Field Control—Duplication

The manual field control is a row of 12's in the program card with the highest order column blank. It is possible to duplicate or skip these fields by key operation. If the DUP key is depressed in the highest order column (blank) R28 is energized as follows: post 76 through the back space switch, R3BU N/O, post 46, duplicate key stem contact, post 45, CF1, (on the Type 26 R22-2), R27-5 N/C, R21-3, R25-2, (on the Type 26 through post 93, rectifier 3, post 99; on Type 24 to R24-4), to grid 5, thus firing tube 5 to pick up R28. The duplication circuits are the same as for auto-duplication. When the 12 program contact makes just after the first escapement gets started, it sets up a hold circuit for R28 and R27 so that the entire manual field will be duplicated. The hold circuit through R22-4 N/C and P4 in parallel and R28-1 establishes the hold for R28 until the 12 program contact drops into the first hole.

Manual Field Control—Skipping

A manual numerical field can be skipped by depressing the dash (—) skip key or the skip key. A manual alphabetic field may be skipped by operation of the skip key.

Dash Skip Key, R21P Coil

The dash skip key will cause the machine to punch an X in the numerical manual field and skip the rest of the field at a speed of 12 ms. per column. The circuit to the 11 interposer magnet and the X skip R21P coil is as follows: post 76 through the back space switch R3BU N/O post 68 (Section 3B), keyboard restoring bail contact to post 67, along the common of the bail contact to the space key latch contact, along the latch contacts common, through the dash skip latch contact, to the asterisk (*) latch contact O/P, the number 11 bail contact O/P, through post 61 and a parallel circuit of the 11 interposer magnet to post 80, and of R30-4 N/C, post 19 resistor 5, post 20, R21P coil and commons to post 80. The 11 interposer magnet will trip the interposer bail contacts and cause an escape and punch cycle during which the X will be punched. R21 has a separate hold circuit through R21-1 and P2 so that it will hold up until 85° of the punch cycle.

Skip R25

At 10° of this cycle, skip R25 will be energized as follows: post 76 through the back space switch, R3BU N/O, to R2BL, R22-4, R21-2, R24-1 N/O, R30-1, P4 P2, through P3, R21-4, R24-2 to RIAU, through post 92, rectifier 2, post 98 to grid 4, thus picking up skip R25. Since the 12 program contact made during the escapement of the escape and punch cycle when the X was punched, R25 will hold up through this program contact and will cause a skip to the end of the field. The skip will not start as soon as R25 energizes but will be delayed until P1 makes at 180°. This delays the escapement until the sensing pins and punches are free of the card. P1 is in series with the escapement magnet for this purpose.

The function of the dash skip key in an alphabetic manual field is to punch an X but not to set up a skip. The R30-4 N/C contacts control R21-P coil since they break to prevent R21P pick up in an alphabetic field.

Skip Key, R21H Coil

The skip key will cause either an alphabetic or numerical manual field to be skipped without punching an X. The skip key latch contact picks up R21 as follows: post 76 through the back space switch, R3BU N/O, post 68, keyboard restoring bail contact to the common of 13, 15, 14 bail contacts, space key latch contact through the skip key latch contact, post 66, post 11 (Section 6B), resistor 1, post 12, R21H coil and post 80. R21-2 (Section 5A) shunts the interposer bail contacts to cause an escape and punch cycle. The pickup of R25 and the resultant skip are the same as for the preceding dash skip key description.

KEYBOARDS

Operation of Contacts

Numerical characters may be punched from the combination keys by the latch contacts. These contacts are operative through R30-2 N/C when the alphabetic field relay 30 is normal. When R30 is energized, the keyboard bail contacts are operative and alphabetic

characters may be punched. Relay 30 will energize for an alphabetic field under control of program contact 1 and through tube 8.

Bail contacts 13, 14, 15 and latch contacts X, skip, *, dash skip, space number 1 and number 9 are operative regardless of field designation. The contacts except the skip, space number 1 and dash skip latch contacts are used for punching special characters and will be found in only those keyboards containing the special keys. An example of a special character combination is the comma percent key which closes bail contacts 14, 15 and 13. These contacts will give a punched code of 0, 4, 8 or 0, 3, 8, depending upon whether the keyboard is controlled numerically (R30 normal) or alphabetically (R30 energized). See the table in Sections 7 and 8 of the wiring diagram for a listing of the contacts operated by the combinational and special character keys.

It is to be noted that the keyboard is normally alphabetic with the star wheels raised because program control lever switch 2 closes when the lever is raised to pick up R30.

Relay 30H Shorted

The hold coil of R30 is shorted *to delay the pickup and dropout* of R30. This is desirable when the units position of a numerical field is punched and an alphabetic field follows. When the interposer bail contact makes for the units position, the escape magnet and keyboard restoring magnet are impulsed simultaneously. In the middle of the escapement, program star wheel contact 1 makes, picking up R30. The keyboard latch and bail contacts must be restored by this time or else the bail contacts will be made operative and trip false interposer magnets. Under the latter condition, the units position of the numerical field would be in error.

Keyboard Restoring Magnets

When punching is being performed manually, the two keyboard restoring magnets are impulsed as the interposer bail contacts make. The circuit is as follows: post 70 through the back space switch, R3BU N/O, to R2BL, through the interposer bail contacts, to the escape armature contact, R25-4, through R28-3 N/C, R25-3 N/C to grid 2, thus restoring any keyboard latch or bail contacts that had been tripped. The only keys that do not operate a latch or bail contact are the ALPH, DUP and NUM keys. These keys operate key stem contacts which are operative as long as the key is held depressed. The space bar has both a latch and a key stem contact.

During the skipping or duplicating operations the keyboard is held restored by the R25-3 N/O and R28-3 N/O points respectively. This prevents any latch or bail contact from closing to cause punching under these conditions.

CF4 in the keyboard restoring circuit keeps the keyboard restored during the feeding operation until 83° of the CF cycle to prevent manual punching until the card is completely registered. If the keyboard were operative at 70°, it would be possible to trip a key and cause machine failure provided an automatic function such as skipping or duplicating was set up in column one of the program card. In the case of skipping, at 70° of the CF cycle when R3 energized, the interposer bail contacts would close to cause an escape and punch cycle but R25 would also be energized to cause a skip. CF4 also serves to restore any keys and contacts that may have been tripped off when the machine was turned off. In this case, the contacts would be restored on the first of the two feed cycles necessary to set up the machine.

Release Key Circuit—with Program Card

The REL key circuit is designed so that *any programmed auto-duplication beyond the column of release will be picked up.* Since this is basically different from other types of IBM card punches, this feature must be remembered.

Release Key

When the REL key is depressed and a manual field is reached, the machine takes a 50 ms. operation for the first column, which is a blank column in manual fields. When the field definition 12's are reached in column 2 of that field and until the end of that field, the card progresses at 12 ms. per column.

Release R1

The REL key causes release R1 to pick up. Relay 1 holds up through its P coil and R1AL in series with program cam contact 2 which corresponds to a last column contact and breaks at column 81-½ of the column indicator.

Escape and Punch Cycle

Relay 1BU N/O will cause escape and punch cycles over all the blank columns of the program card as

follows: post 76, through the back space switch, to R3BU, R1BL, through R1BU, R3BL N/O, program control lever switch 1 N/C, R25-3 N/C, R28-3 N/C, R25-4 N/C, R24-3 N/C, R22-3 to grid 3 causing the escapement to operate. This circuit shunts the interposer bail contacts so that a normal escape and punch cycle will result.

Skip R25P

When the machine spaces over into the 12's of a manual field definition, skip R25 will pick up to give a skip for the duration of the 12's. The circuit to skip R25 is as follows: post 76, through the back space switch, R3BU N/O, post 42, to program control lever switch 2, through the 12 program contact, R28-2 N/C, R1AU, post 92, rectifier 2, post 98, to grid 4, thus picking up relay 25.

The R1BU circuit, shunting the interposer bail contacts to give an escape and punch cycle over the blank column in the highest order of an manual field, is inoperative when skipping or auto-duplicating because of the R25-3 N/C and R28-3 N/C points respectively. Auto-duplicated and auto-skipped fields will be picked up as under normal operations. With numerical keyboards R27-3 and the 1 program contact permits auto-spacing over the blank columns of a duplication field.

Skip Relay 25 Hold Coil Shorted

The purpose of shorting R25H coil is *to delay the dropout of R25* when moving from a skip field into an auto-duplicated field so that R28 is certain to be energized before R25 drops out. This is necessary to permit R1BU point from operating as a shunt around the interposer bail contacts in this column. Because this is the first column of an auto-duplicated field, the correct operation is a pin sensing cycle in which the interposer bail contacts should be closed by the tripping of an interposer magnet through a pin sensing contact. R25H shorted also prevents the dropout of R25 when passing from the 11 to the 12 program contact in a skip field if there is no overlap of the program contacts.

Release Key Circuit—Not Programmed

When the program star wheels are raised or when card lever R3 is normal, the REL key should cause a skip to column 80 of the detail card (81 on column indicator). The star wheels will be raised when punching without a program card as in random punching or error correction. The most common operation involving a release cycle when R3 is normal is the insertion of previously punched master cards at the reading station to replace a detail card which has just been punched and would normally become the master card. This is the operation of punching and duplicating with the use of previously punched master cards. In this case, the auto-feed switch is turned OFF sometime during the punching of the last detail card of the group. When punching of this last card has been completed, it is pushed manually into the read station feed rolls and the REL key is depressed.

The last detail card will be ejected to the stacking position and the new master card is inserted at the read station.

Skip R25 and Escape Magnet

In both of these cases, the release should be a skip at 12 ms. per column. The circuit to pick up R25 and the escape magnet is as follows: post 76, through the back space switch, to R3BU O/P, R1BL O/P, through R1BU, R3BL N/C or program control lever switch 1 N/O to R25-4 N/O, through post 98 to grid 4 which energizes R25 as well as the escape magnet when R25-4 transfers. A circuit is then completed through R25-4 N/O, R24-3 N/C, R22-3 to grid 3. This circuit will keep R25 and the escape magnet energized until R1 drops out at program column 81½.

The purpose of R1BL in the keyboard restoring circuit is to restore the keyboard on a release when R3 is normal or when the program star wheels are raised. It is wired directly to the magnets thus shunting around tube 2 to avoid a possible extra release cycle which may result if the REL key were depressed immediately after the machine were turned on and before the tubes were warmed up. If R1BL were wired to the grid of tube 2, and this tube were much slower in heating up than tube 3 (escape magnet), R1 would not drop out at program column 81½ on a release because the pickup circuit would still be operative and an additional release operation would result.

Multiple Punching in One Column

It is possible to multiple punch in one column by holding the space bar depressed fully to close the key stem contact and then operating the keys for the desired punches. When the space bar is depressed, the space key latch contact energizes the space interposer magnet closing the interposer bail contact and causing an escape

and punch cycle. Nothing will be punched and the card will stop in a blank column up to this time.

Multiple Punch R24

When the escape armature contact closes, multiple punch R24 is energized as follows: post 76, through the back space switch, R3BU N/O, to R2BL, through the interposer bail contacts, escape armature contact, R24-1 N/C, R28-6, space key stem contact to grid 6, picking up R24.

Relay 24—Impulse Timing

The .25 MFD capacitor from grid to cathode of tube 6 assures a good pickup impulse to R24. So long as the space bar is held down, R24 will be held energized as follows: post 70, through the back space switch, R3BU N/O, to R2BL, R22-4, R21-2, through R24-1 N/O, R28-6, space key stem contact and to grid 6, holding tube 6 conductive and R24 up. It should be noted that R24 picks up at the same time as R22.

R24-3 N/C breaks to prevent any further impulses to the escape magnet when the interposer bail contacts close. Instead of initiating escape cycles, R24-3 N/O closes to transfer the impulses through the interposer bail contact, to grid 7 thus causing the punch clutch magnet to operate for each key operation.

R24-2 breaks to prevent the pickup of skip R25 in the event that multiple punching is done in the units position of a field which is followed by an auto-skip field. While multiple punching is being performed in the units column, the 11 star wheel will be in the 11 hole of the program card for the adjacent auto-skip field. This includes column 80 when program cam contact 1 is made.

R24-4 breaks to allow multiple punching in the units position of a field which is followed by an auto-duplicated field.

EJECT CIRCUIT

Auto Feed Switch ON

When the auto-feed switch is ON, the program cam contact 2 N/O operates the card feed clutch magnet. This occurs between cards or between program columns 82 and 87½. The circuit is as follows: post 76 through program cam contact 2, post 72, auto-feed switch ON, post 71, card feed clutch magnet and post 80.

On a card feed cycle, the master and detail cards are registered for reading and punching. A new card is fed from the hopper, and the card at the eject station is stacked.

Auto Feed Switch OFF

With the auto feed switch OFF, the feed and register keys must be operated to make the machine operative. The feed key impulses the card feed clutch magnet as follows: post 76, through the back space switch, R3BU N/C, post 69, feed key latch contact, post 71, to the card feed latch magnet contact, through the card feed clutch magnet and post 80.

The function of the register key is to cause a card feed cycle but the feeding of a new card will be blocked by the operation of the card feed latch magnet armature. The circuit to the CF latch magnet is: post 70, through the back space switch, R3BU N/C, post 69, to the feed key latch contact, through the register key latch contact, post 70, CF latch magnet and post 80. The CF latch magnet contacts make the hold circuit for the CF latch magnet through CF2 and also pick up the CF clutch magnet.

AUXILIARY DUPLICATING FEATURE

(See Wiring Diagram 228225)

THIS FEATURE permits duplicating from an auxiliary storage drum located below the program drum. Relay 28 is exchanged for one with a P and H coil and R7 and R34 are added. The punches in the auxiliary duplicating card are read one column ahead of the detail card by star wheels similar to the program drum contacts.

Auxiliary duplicating is initiated by depressing the AUX DUP key in the highest order column of a manual field. The AUX DUP key latch contact energizes the R28H coil and R7P coil in parallel. Relay 28 will be held up by its P coil in the tube 5 plate circuit and R7H will be held up through tube *14 by R28-1 and R22-4 N/C with P4 in parallel. This hold circuit is effective until the first escapement is under way. The 12 program contact makes on this first escapement and holds for the duration of that field.

R7BU picks up R34. Relay 34 makes the auxiliary duplicating drum contacts operative for this field by transferring the control of the interposer magnets from

the sensing pin contacts to the auxiliary duplicating contacts.

R7BL in series with the R21P coil breaks to prevent a skip when an X is duplicated from the auxiliary duplicating drum.

ALTERNATE PROGRAM FEATURE

(See Wiring Diagram 228471)

THE ALTERNATE program permits shifting the program control from the top channel of 12 through 3 holes to the lower channel of 4 through 9 holes in the program card. Depression of the ALT PROG key causes R39 to energize through the alternate program latch contact, post 82, resistor 10, R39 coil and post 80. Once up, R39 will hold through R39-1 point and program cam contact 2.

The second channel will remain operative until column 81½ of the program index, therefore, the feature remains in control for the balance of the card.

PRINT CIRCUITS

Zero Print Suppression

The suppression of zeros to the left of the first significant digit in a field is automatic on the Type 26 Printing Punch and operates under control of the field definition 12's. Until a significant digit 1 through 9 is punched, either by key or sensing contact, print R31 will be normal.

Print Suppress Magnets

The 12 program contact will keep the print suppress magnet energized and zero printing will be suppressed as follows: post 76, through the back space switch, R3BU N/O, post 42, to program control lever switch 2, through the 12 program contact, to R28-2 O/P, through R25-1 N/C, post 94, rectifier 4, post 100, R31-1 N/C, R21-5 and grid 9, thus energizing the print suppress magnet.

Print R31

As soon as a significant digit is punched, print R31 will energize and the above circuit will transfer through R31-1 N/O to grid 10 and hold up R31 through tube 10 for the duration of the program 12's. Thus, all numbers, including zeros, will be printed in this field from that column to the end of the field.

The hold circuit for R31 through R31-2 N/O and P4 with R22-4 N/C in parallel is essential to hold R31 up until the machine spaces into the first 12 program hole of an auto-duplication field if a significant digit appears in the highest order column of this field. Then, the 12 program holes will set up a hold circuit for R31 as described above.

It is advantageous to note that should a field be punched all zeros, the zero in the units position cannot be print suppressed.

At punching and printing time, the 12 star wheel will be in the highest order column of the following field, hence it will not be reading the 12 hole. However, a field that is all zeros should be skipped and should not be punched or printed.

PRINT SUPPRESSION

Star Wheel Contact 3 (Figure 92)

The program card control for print suppression is the 3 hole. Any column or field that is to be print suppressed should have the program card punched with a 3 in that column or field. The 3 punch star wheel is

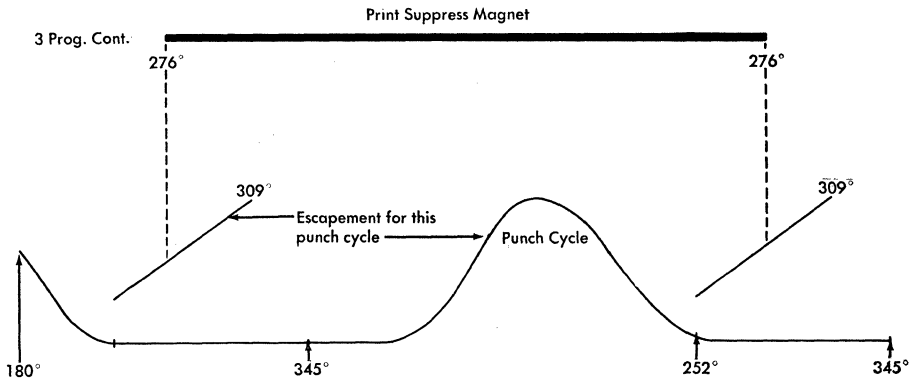


Figure 92. Sequence Chart—Print Suppression

designed to read one column later than the 12, 11, 0 and 1 star wheels. It could also be stated that the 3 star wheel contact makes one column late. For example, if program card column 5 is punched with a 3 hole, the late reading star wheel will drop into the 3 hole during the escapement on the escape and punch cycle on which detail column 5 is being punched. Consequently, the 3 program contact will be made when detail column 5 is being punched and printed and may be used to cause print suppression. It will break with the following escapement of the escape and punch cycle that detail column 6 is to be punched so that normal printing will be resumed in detail column 6.

Print Suppress Magnet

Program contact 3 drives grid 9 to cathode potential energizing the print suppress magnet which blocks printing as follows: post 76, through the back space switch, R3BU N/O, post 42, to program handle switch 2, the common of program contacts, through the number 3 contact to R21-5 and grid 9.

ZERO PRINT FORCING

Star Wheel Contact 2

It is possible to force the printing of zeros to the left of the first significant digit or special characters using only a zone punch by punching a two in the program card in the columns involved. This star wheel is similar to the 3 star wheel and also reads one column late. Consequently, a 2 hole in program column 5 would cause the 2 program contact to make on the escape and punch cycle during which column 5 is being punched and printed. Program contact 2 is wired to the screen grid of tube 9 and drops the potential from the normal plus value of the plate voltage to cathode potential, thus blocking the tube. The print suppress magnet will then de-energize and allow printing in that column or field. For comparison, program contacts 12, 11, 0 and 1 make a column ahead of the detail card to initiate controls, but since printing is driven by the punch clutch and set up by the punches themselves, program contacts 2 and 3 make and control on the column of the operation they control.

R1 Release (6B)

This relay under control of the release key latch contact will cause a card to skip all the way out if not programmed. When programmed, it will cause skipping over all manual fields but the machine will follow other programmed controls.

R1AL (6B) with program cam contact 2 provides a hold for release R1 until column 81½ of the column indicator.

R1AU (6A) in conjunction with duplicate 1 relay 28-2 N/C and the number 12 program contact places a zero potential on grid 4. This picks up skip R25 to give a skip over the 12's of a manual field definition by shunting the interposer bail contacts.

R1BL (5A) shunts CF4 and causes the keyboard restoring magnets to lock up the keyboard during a release, provided card lever R3 is normal or the program star wheels are raised. This point also by-passes the grid of tube 2 to prevent an extra cycle when the machine is first turned on and the REL key struck before the tubes have warmed up.

R1BU (5A) on release operations, shunts the interposer bail contacts to give an escape and punch cycle over each of the blank columns in the program card.

R2 Duplicate 2 (6B)

Since a pin sensing cycle is essential to start an auto-duplication cycle, R2 through duplicate 2 relay 2 and duplicate 1 relay 28-4 performs this function.

R2AL (5B) is the hold point for duplicate 2 relay 2 through cam P2.

R2AU. Not used.

R2BL (5B) with card lever R3 drives grid 7 to zero thus energizing the punch clutch through tube 7 for a pin sensing cycle.

R2BU (5B) with P3 energized duplicate 3 relay 27 by its hold coil to complete the circuit from the sensing pins to the interposer magnets for duplication.

R3 Card Lever Relay (4B, 6B)

This relay picks up on the second card feed cycle and holds up for the entire card as well as for each succeeding card but will drop between cards from column 81½ through 88 (0) of the column indicator. The purpose of R3 is to make operative the punching, duplicating, and program circuits.

The BU contact assembly consists of two N/O contacts and one N/C contact to the armature. The reason for the split circuits on the N/O contacts is to prevent a back circuit which would cause punching, duplication or any other function when R3 is normal between cards or before the first card is registered. The back circuit would place the +potential on any of several possible control grids through an interposer magnet and its latch contact (tripped), keyboard control contacts, R3BU a program drum contact, and any control grid. This could put the program out of step with the card when it is registered.

R3AL (6B) is the hold point for card lever R3 through program cam contact 2.

R3AU (6B) with the auto-feed switch OFF, breaks the circuit from the +potential at the screen grid to tube 9 to program contact 2, when card lever R3 is normal. When a 2 and 0 are programmed in column 1 with card lever R3 normal, without this point it would be possible to energize duplicate 1 R28 through the 2 and 0 program contacts which would cause tube 5 to conduct. At this time, a release would be obstructed since the zero contact would start auto-duplication. Therefore, in order that a release may be operated if it is so desired from column 1, this point is provided to hold up duplication until R3 is energized by the register key.

R3BL N/C (5A) breaks to prevent a release over the entire card when programmed and the release key is depressed.

R3BL N/O (5A) holds the keyboard restoring magnets energized until column 81½ of the column indicator. This prevents the latch or bail contacts from causing punching on a release.

R3BU (INNER) N/O (5B) closes to make all the 25L6 grid circuits operative including the program card controls.

R3BU (OUTER) N/O (5B) closes to make the keyboard operative.

R3BU N/C *(5B)* breaks the circuit to the register key and the feed key to prevent these operations when card lever R3 is energized.

R21X Skip (4A, 6B)

This pickup coil of R21 is in parallel with the 11 interposer magnet but under control of the alphabetic field R30-4 points. The skip key causes an X punch then a skip when R30 is normal (numerical). The hold coil is energized through the skip key and will cause only a skip in either field.

R21-1 (5B) is the hold point for X skip R21 through P2.

R21-2 (5A) shunts the interposer bail contacts to cause an escape and punch cycle to skip the first column of a manual skip field. This provides a 50 millisecond per column space over the first column of a manual field definition until skip R25 is picked up for a skip (12 ms. per column).

R21-3 (6A) prevents energization of the duplicate relays while skipping.

R21-4 (5B) places zero potential on grid 4 to pick up skip R25. This takes place when P3 makes during the X punch, or the first column space for a manual field skip.

R21-5 (6B) prevents grid 9 from being zero biased while shipping. This point is a double check on R25-1 N/C.

R22 Escapement Interlock (6A, 6B)

This relay drops the escapement armature into the next tooth of the escapement wheel for single column operations. By driving grid 7 to cathode potential, R22 causes the plate circuit of tube 7 to energize the punch clutch.

R22-1 N/C *(5B)* breaks to prevent a second pickup of duplicate 2 relay 2 when manual duplicating and when the duplicate key is held depressed. When duplicate 3 relay 27 drops out and duplicate 1 relay 28 is re-energized, if it were possible to also energize duplicate 2 relay 2 and duplicate 3 relay 27, it would cause pin sensing while punching; this would eliminate the extra cycle desired for 100 millisecond manual duplication cycles.

R22-1 N/O *(5B)* provides a hold circuit for interlock R22 through P2.

R22-2 (5A) (Type 26 only) is an interlock between R28 and print R31. It insures that print R31 is returned to normal between columns before R28 is re-energized when duplicating with the DUP key.

R22-3 (6A) opens to return grid 3 to –49 volts bias thus shutting off tube 3 and allowing the escapement armature to fall back into the following tooth on the escapement wheel.

R22-4 N/C *(5B)* establishes a hold for duplicate 1 relay 28 over the first column of a manual field (blank in the program card).

R22-4 N/O *(5B)* drives grid 7 to zero thus energizing the punch clutch in the plate circuit of tube 7.

R24 Multiple Punch (6A)

Energized when the space key is held depressed, this relay allows a single column escapement but prevents additional escapement in order that multiple punching may be accomplished.

R24-1 N/C *(6A)* breaks the circuit to grid 1 thus preventing the pickup of interlock R22 on multiple punch cycles.

R24-1 N/O *(6A)*, with the space key contact, holds multiple punch R24 (grid 6).

R24-2 (6A) breaks to prevent the pickup of skip R25 when multiple punching in the units position of a field which is followed by an auto-skip field. This includes column 80 when program cam contact 1 is closed. When multiple punching in the units column, the 11 star wheel contact will be made in the first position of the auto-skip field.

R24-3 N/C *(6A)* breaks the circuit to grid 3 to prevent energizing the escapement on multiple punch cycles.

R24-3 N/O *(6A)* completes the circuit to the punch clutch on multiple punch cycles (grid 7).

R24-4 (6B) breaks the circuit to auto-duplicate grid 5 on multiple punch cycles. This point also permits multiple punching in the units position of a field which is followed by an auto-duplicated field.

R25 Skip Relay (6A)

This relay provides a skip over the 12's of a field definition under control of an auto-skip 11 hole in the program card or the manual release key.

The reason for shorting the hold coil of this relay is to delay the dropout of R25 when moving from a skip field into an auto-duplicate field so that duplicate 1 R28 has time to pick up. This is necessary to prevent re-

lease R1BU from shunting the interposer bail contacts in this column.

R25-1 N/C *(6A)* prevents the print suppression magnet from being energized while skipping.

R25-1 N/O *(6A)* keeps zero bias on grid 4 through program 12 contacts which holds up skip R25 over the field definition.

R25-2 (6A) prevents the pick of duplicate 1 relay 28 while skipping.

R25-3 N/C *(5A)* on a release, prevents shunting around the interposer bail contacts while program auto-duplicating or auto-skipping. This point breaks also to prevent escape and punch cycles on a skip.

R25-3 N/O *(5A)* keeps grid 2 at zero potential thus holding the keyboard restoring magnets energized to prevent any latch or bail contact from closing to cause punching while skipping.

R25-4 N/O *(6A)* places the escapement magnet grid 3 under control of release R1BU N/O so that on a release, with card lever R3 normal, the card will skip all the way out.

R27 Duplicate Relay 3

This relay, picked up through its hold coil by duplicate 2 relay 2BU N/O points, renders the sensing pin contacts operative for duplication. Relay 27 holds through its pickup coil in parallel with duplicate 1 R28 in the plate circuit of tube 5.

R27-1 (6A) is the hold point for R27 P coil in parallel with R28.

R27-2 (4B) in series with P5 closes the circuit from the minus side of the line to the pin sensing contacts for duplication.

R27-3 (5A) in series with alphabetic field R30-1 N/O makes it possible to auto-space over blank columns in a duplicated field by shunting the interposer bail contacts and causing escape and punch cycles over the entire field. If a blank is sensed when auto-duplicating is taking place in a numerical field, it will be necessary to operate the alphabetic field key or punch program 1's for these columns.

R27-4 (5B) prevents duplicate 2 relay 2 from being re-energized through P2 while auto-duplicating to prevent extra pin sensing cycles.

R27-5 N/C *(6A)* breaks the circuit to the duplicate key each column of operation which in turn drops duplicate 1 relay 28. This insures an additional pin sensing punch clutch cycle when manual duplicating without a program card.

R27-5 N/O *(6A)* with R28-2 N/O places grid 5 (R28P and R27H) under hold control of the 12's in the field definition of the program card.

R28 Duplicate Relay 1 (6A)

Relay 28 is the duplication control relay since it is the first of these duplicate relays energized by a program zero or the duplicate key. This relay normally picks up duplicate 2 relay 2 and duplicate 3 relay 27.

R28-1 (6A). When R28 is energized through the zero contact of the program card, a hold is established through this point until after the first escapement starts.

R28-2 N/C *(5A)* on a release operation, when programmed, breaks the skip circuit from the 12 contact of the program card to grid 4 and drops out skip R25.

R28-2 N/O *(5A)* in conjunction with R27-5 N/O provides a hold circuit through the 12 program contact for R28 by keeping grid 5 at zero potential (for auto-duplicate fields).

R28-3 N/C *(5A)*, when programmed on a release operation and when an auto-duplicate field is sensed by the zero star wheel contact, prevents the interposer bail contacts being shunted.

R28-3 N/O *(5A)* holds the keyboard restoring magnets energized while auto-duplicating.

R28-4 (6B) is the pickup for duplicate 2 relay 2 to provide a pin sensing cycle at the start of duplication.

R28-5 prevents a numerical shift while duplicating under alphabetic program control by shunting the NUM key stem contact.

R28-6 (6A) makes it impossible to energize multiple punch R24 from the space bar while duplicating.

R30 Alphabetic Field Control (6B)

This relay is not used with a *numerical* keyboard. Relay 30 contacts switch the combination keyboard from alphabetic to numerical. It is to be noted that the keyboard is normally alphabetic when there is no program card in the machine. When the program star wheels are raised, program control lever switch 2 closes to energize R30 through tube 8.

Relay 30 H coil is shorted *to delay the pickup and the dropout.* This is desirable when the units position of a numerical field is punched and an alphabetic field follows. When the interposer bail contacts make for the units position, the escape magnet and keyboard restoring magnet are impulsed simultaneously. In the middle of the escapement, program contact 1 makes picking up R30. The keyboard latch and bail contacts must be restored by this time or else the bail contacts will be made operative and trip false interposer magnets; thus, the units position of the numerical field would be in error.

R30-1 (5A) when closed along with duplicate 3 relay 27-3 N/O shunts the interposer bail contacts to cause auto-punch and escape cycles over blank columns of a master card on auto-duplication.

R30-2 N/C *(3B)* breaks the circuit to the keyboard latch contacts when the keyboard is alphabetic.

R30-2 N/O *(3B)* makes the keyboard bail contacts operative for alphabetic punching.

R30-3 (3B) renders the alphabetic special character bail contacts operative (keyboard bail contact 12, 11, 10 and 8).

R30-4 (4A) breaks when the keyboard is alphabetic to prevent a skip and allow an X punch only.

R30-5 N/C *(4A)* selects the punch interposer 3 magnet for numerical keyboard special characters when keyboard bail contact 15 closes.

R30-5 N/O *(4A)* selects the punch interposer 4 magnet for alphabetic keyboard special characters when keyboard bail contact 15 closes.

R31 Print

Since suppression of zeros to the left of the first significant digit in a field is normal on this machine, print R31 must be energized to print. The pick and hold coils of this relay are in series with separate groups of interposer magnets so that no two interposer magnets will be energized in parallel series with either of the windings. Thus energizing any interposer magnet numbers 1 through 9 will also bring up R31 to cause printing and overcome suppression from then on in that field.

R31-1 N/C *(5B)* breaks the circuit to grid 9 dropping out the print suppression magnet.

R31-1 N/O *(5B)* holds zero bias on grid 10 to keep print R31 energized over the 12's of a field definition.

R31-2 (5B) provides a hold with P4 and R22-4 in parallel until the first 12 hole is sensed in the program card when a digit is printed in the first column of an auto-duplication field.

Cams and Contacts

CF1 (5A) in series with the DUP key makes this key inoperative until 90° of a card feed cycle so that machine failure will not result in the event that the DUP key is held depressed between cards and there is an auto-skip hole in column 1 of the program card. If this cam were not in the circuit, the auto-skip R25 and the auto-duplicate R28 would be impulsed simultaneously when card lever R3BU N/O closes. This condition would occur only if the auto-feed switch were ON so that a card feed cycle was initiated between program columns 82 and 87.

CF2 (3B) is the hold point for the card feed clutch magnet and the card feed latch magnet but breaks to de-energize them before latch time. This cam contact makes at 330° so that, should two successive feed cycles be desired, there would be no delay between them.

CF3 (3B) breaks before the card lever contact closes on first cycles but energizes card lever R3 on its second and each succeeding card operation. The card is registered at 55°, and CF3 closes at 70° to start operations.

CF4 (6A) is in the keyboard restoring circuit to keep the keyboard restored until 86° of a card feed cycle so that punching may not be started before the card has been completely registered for punching at 70°. If the keyboard were operative before 70°, it would be possible to trip a key and cause machine failure if an automatic function such as skipping or duplicating was set up in column one of the program card. In the case of automatic skipping, at 70° of the card feed cycle when card lever R3 energized, the interposer bail contacts would close to cause an escape and punch cycle but skip R25 would also pick up to cause a skip. CF4 also serves to restore any key or keyboard contact that may have been tripped while the machine was turned off. In this case, the keyboard contacts would be restored on the first of the two card feed cycles necessary to set up the machine.

P1 (6B) delays the pickup of the escape magnet until 180° of the punch cycle. When the units position of a field which is followed by an auto-skip is being punched, the delay in the escape magnet pickup allows the punches and sensing pins to be retracted from the card before escapement.

P2 (5B) holds escape interlock R22 energized until 85° on punch cycles so that the punch clutch may be re-energized while auto-duplicating. This prevents the punch clutch from latching up. Although the clutch armature will drop out, it will be re-energized before latch time at 345° of the punch index.

P2 also holds duplicate 2 relay 2 until 85° thus insuring that the pickup impulse for R27 gets through at 0° to make the sensing pins operative.

P3 (5B) impulses skip R25 at 10° of the punch cycle to set up an X skip. This cam control also permits R2 to energize R27 on the early part of the pin sensing cycle so that the sensing circuit is operative before the sensing pin contacts close. P3 makes this late to prevent a stray impulse from energizing the punch clutch or escape magnets before P1 breaks at 0° while turning the machine over by hand.

P4 (5B) is wired in parallel with interlock R22-4 N/C to set up a hold for duplicate relays 27 and 28 until the 12 program contact makes if the DUP key is depressed in a manual field when programmed.

P5 (4B). This cam is a circuit breaker for the sensing pin contacts. It makes after and breaks before the sensing pin contacts to take the arc off these contacts.

Selenium Rectifiers or Polarity Traps

Selenium Rectifier 1 (2A) is in the –49V grid bias power supply.

Selenium Rectifier 2 (6A) prevents the energization of the punch clutch on a release cycle with card lever R3 normal in the event of an overlap of the 12 and zero program contacts. For example, the 12 program contact may overlap the zero program contact when the card passes from the units column of a manual field in which a 12 appears, into the highest order of a field in which a zero appears. In this event, the punch clutch magnet will receive a false impulse and interrupt the skip of the release cycle.

The direction of electron flow for this circuit would be from the –49 volt bias supply through grid 5 bias resistor to post 99, through R24-4 post 78, *auto-skip-auto-dup* switch (right) ON, post 75, zero program contact, 12 program contact, R28-2 N/C, R1AU, post 92, rectifier 2, post 98, to R25-4, through R3BL N/C, R1BU, to R1BL, R3BU O/P, the back space switch and post 76 which is cathode potential. Selenium rectifier 2 prevents electron flow in this direction thus preventing grid 5 rising to cathode potential under these conditions.

Selenium Rectifier 3 (6A) is used on the Type 26 Printing Card Punch only. It assures that zero print suppression to the left of the first significant digit will be operative field by field. It prevents print R31 from holding up erroneously when moving into an auto-duplicated field from a manual field which has been duplicated by depressing the DUP key on the keyboard.

Under these conditions duplicate relays 27 and 28 do not drop out when moving from the units position of the manual field into the highest order position of the auto-duplicated field in which a zero appears in the program card. Consequently, uninterrupted duplication occurs to the end of this auto-duplicated field.

Selenium rectifier 3 assures the de-energization of print R31 as the machine moves into the auto-duplicated field so that it may be energized correctly, from the interposer magnet circuit.

The direction of electron flow for the circuit blocked by rectifier 3 is; from –49 volt bias supply through grid 10 bias resistor, R31-1 N/O, post 100, selenium rectifier 4, post 94, R25-1 N/C, R28-2 N/O, R27-5 N/O, R21-3, R25-2, post 93, selenium rectifier 3, post 99, R24-4, post 78, auto-skip, auto-duplicate switch (right) ON, post 75, zero program contact, along the common of the program contacts to the 12 contact, program control lever switch 2, through post 42, card lever R3BU N/O, the back space switch and post 76 to cathode potential.

The flow for a parallel circuit blocked by rectifier 3 is: –49 volt bias supply, through grid 10

bias resistor, to R31-1 N/O through R31-2 to R22-4, through R28-1, post 93, selenium rectifier 3, post 99, R24-4, post 78, auto-skip, auto-duplicate switch (right) ON, post 75, zero program contact and out to post 76 at cathode potential as above. Thus, tube 10 will shut off on the highest order column of the auto-duplicated field and print R31 will be de-energized.

Selenium Rectifier 4 (Section 6A on 26 Printing Punch only). This rectifier prevents the 3 program contact from causing skipping or duplicating too far. For example if two adjacent manual fields are both programmed with 3's for print suppression in every column, and the first field was duplicated by key, rectifier 4 prevents the 3 program contact from holding up duplicate relays 27 and 28 at the end of the first field.

The direction of the electron flow for the circuit blocked by this rectifier is: –49 volts bias supply through tube 5 grid resistor, post 99, rectifier 3, post 93, R25-2, R21-3, R27-5 N/O, R28-2 N/O, R25-1 N/C, post 94, rectifier 4, post 100 R31-1 N/C, R21-5, program contact) to the 12 program contact program control lever switch 2, through post 42, R3BU N/O, the back space switch, and post 76 at cathode potential.

Selenium Rectifier 5 (4B) is used only for combination keyboards with special characters on the Type 26 Printing Card Punch.

Without this rectifier it would be possible to double punch letters which contained an 8 or 9 punch and a zero punch that were in the master card while manually punching a similar combination from the keyboard. The circuit would operate through the sensing pins closed at this time as follows. In Section 6B when tube 10 conducts to permit printing, it is possible for current to pass from the plate side of R31H coil, to the common for interposer magnets 8 and 9, through either coil to a closed sensing pin contact, through another sensing pin contact closed for a zone punch, its interposer magnet, common strap, common of card feed clutch and post 80. Thus tripped, these two interposer magnets could cause extra punches to appear in the column following the manual punches.

Wire Printing

In order to form a clear picture of wire printing, consider first the wires and the function they perform; an explanation of how the various codes are setup or selected to form characters will then be more readily understood.

A rectangular funnel with a curved spout provides individual passages or tubes for the insertion of sturdy, flexible wires (Figure 93).

At the small end of the guide, the wires converge in a rectangular form which is the overall size of a letter. Striking the wires at the open end of the funnel in a pattern, the wires at the small end will leave the selected impression through a ribbon on a card. In the print unit .012″ diameter music wires (also known as piano wires) are used (Figure 95).

A code plate was designed with projections which outline all characters. If the code plate is squeezed against the wires, only those wires struck by the projections will leave impressions. Thirty-five wires are sufficient to form all the letters of the alphabet in addition to zero, the digits 1 through 9 and several special symbols (Figure 96).

The code plate projections are so dispersed that, by manipulating the code plate vertically, horizontally, or both, the same code plate can be used for all characters. All that remains is a method of shifting the code plate to the desired area. This is accomplished through linkage by the punch extensions.

A system of punch operated interposers which function in measured units according to the letter code or character punched, through linkage, positions the code

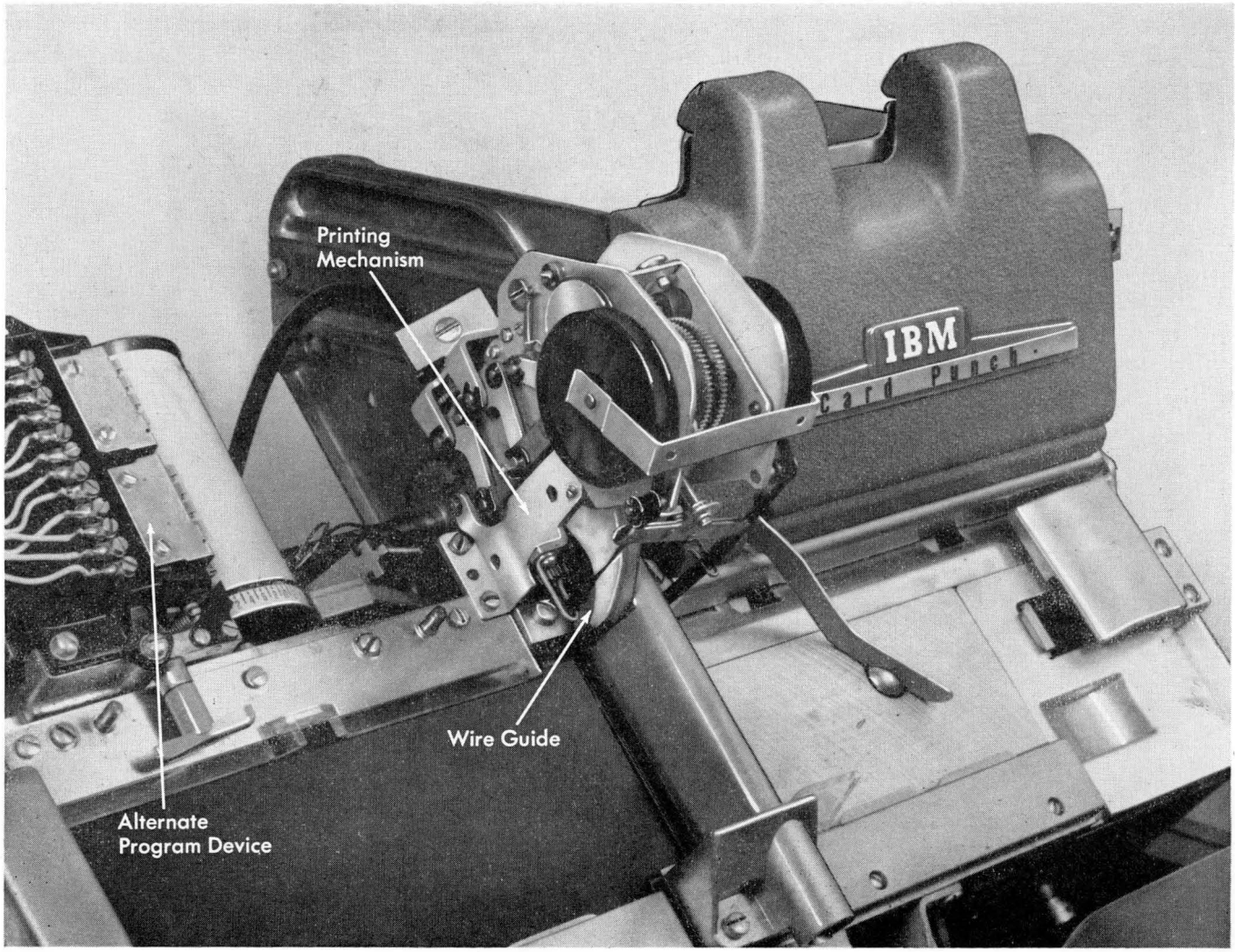


Figure 93. Printing Mechanism—Front View

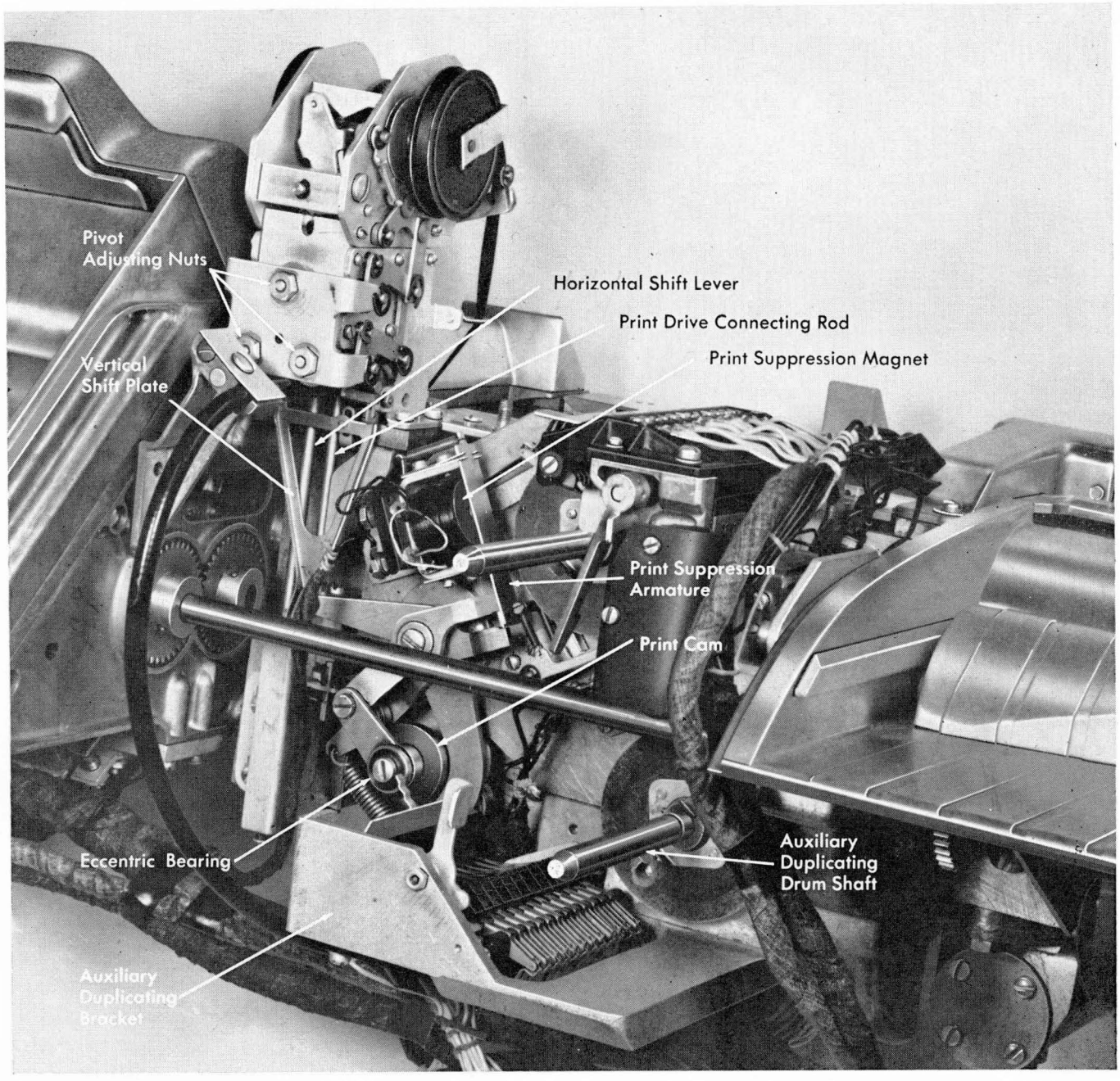


Figure 94. Printing Mechanism—Rear View

plate so that the projections of the code plate will only strike wires to form the corresponding character. It should be established that the letter, in order to be printed, must also be punched.

By combining the punching of the card and the shifting of the code plate, all motion is controlled and operated through the revolution of the punch shaft. A mechanical print cam is added to the punch shaft outside of the punch index which operates the linkage to squeeze the code plate against the wires and print. Thus, the punch shaft operates the punches and the print plate, while the punches, in their travel through the card, shift the code plate so that the corresponding character which is punched is also printed. (Figure 94).

Print Wires (Figure 95)

A collar is crimped on each printing wire near the end operated by the code plate. These collars provide a means of restoring the wires by the return plate after printing. As each assembly of wires is constructed, the operating ends are ground square thus making the various length wires even at their printing ends.

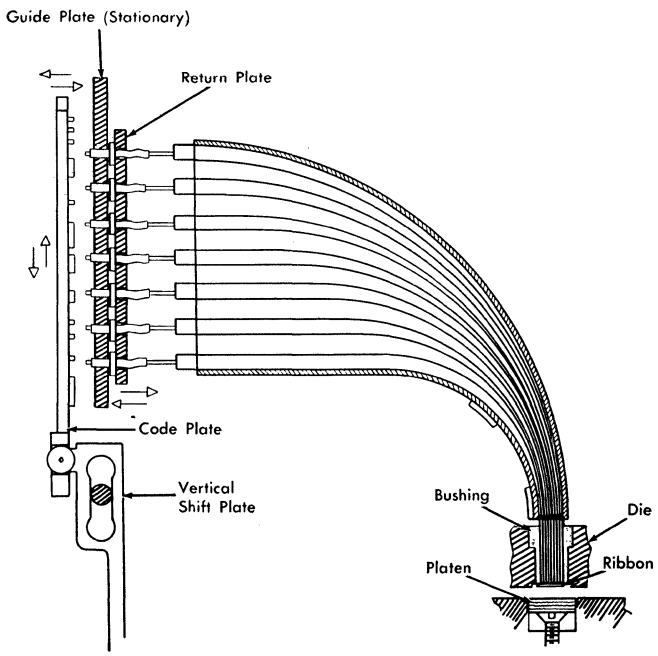


Figure 95. Wire Guide Assembly

It is not advisable to replace one wire because they are completed as a unit. At the small end of the wire, guide separators keep the rows of wires aligned since they have a tendency to sandwich when they start to wear.

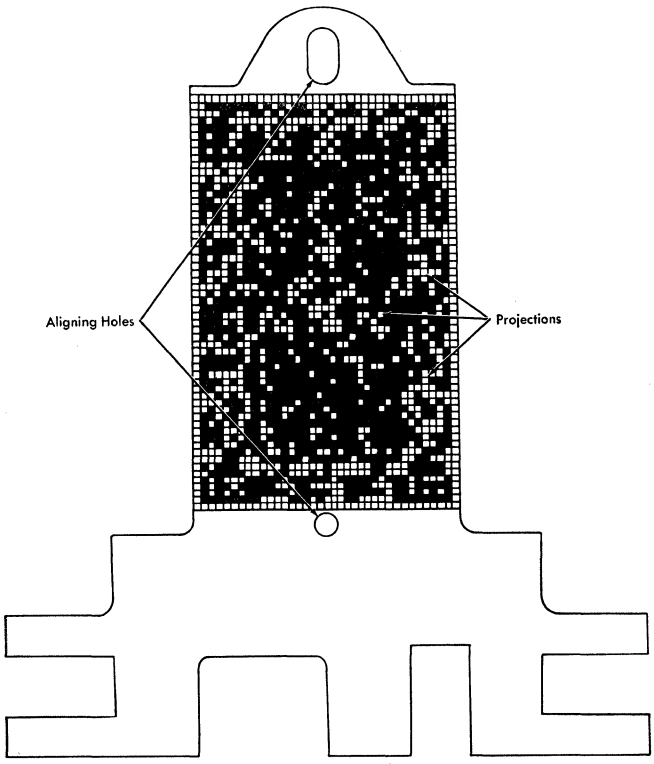


Figure 96. Printing Code Plate

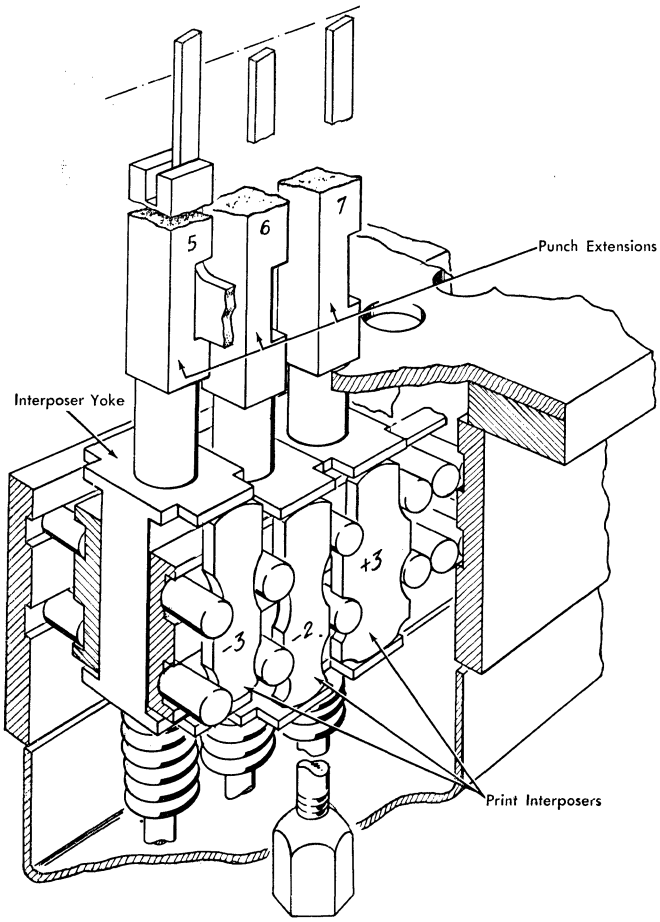


Figure 97. Type 26 Punch Extensions

Code Plate

The projections on the code plate form nondescript outlines. When adjacent, these projections are combined as shown in Figure 96. The top surface of an individual projection is .015″. Center to center, adjacent projections measure .022″, therefore, with the code plate approximately ¾″ wide by 1¼″ high, it is possible to have 34 by 55 projections, respectively. The punch interposers are designed to move the code plate in units of .022″. The normal resting place for the code plate is blank so that nothing is printed while spacing or during the pin sensing punch shaft revolution to start auto-duplication.

Print Interposers

Two sets of print interposers position the code plate. Because the print unit is more accessible from the rear of the machine, directions and description will be from that vantage point. The set of print interposers to the left of the punch extensions operate a slide to position the code plate vertically and those to the right of the extensions move the code plate horizontally.

In Figure 97 the quantity of cam operation is stated in whole number units as plus or minus. The units of cammed motion imparted to their respective *slides* are the stated quantity times .020″. If a punch is operated whose cam is a plus 3, the movement imparted to its slide will be .060″.

The motion of each slide, which in turn shifts the code plate, has the ratio of 10 to 11, that is, .020″ motion to either slide moves the code plate .022″.

Punch Extension

The punch extensions on the Type 26 Printing Card Punch extend beyond the lower guide to operate the print interposer mechanism. A slide and compression spring are held on each punch extension by a self-locking nut.

In Figure 97 assume that the number 5 interposer magnet is impulsed. After the escapement, the punch bail causes the number 5 punch operating arm to raise its punch. As the punch extension is lifted, the yoke is forced to rise with it and to slide its print interposer up.

As the print interposer is raised, the rollers against which it operates cause the horizontal slide to move minus 3 or .060″ toward the front of the machine.

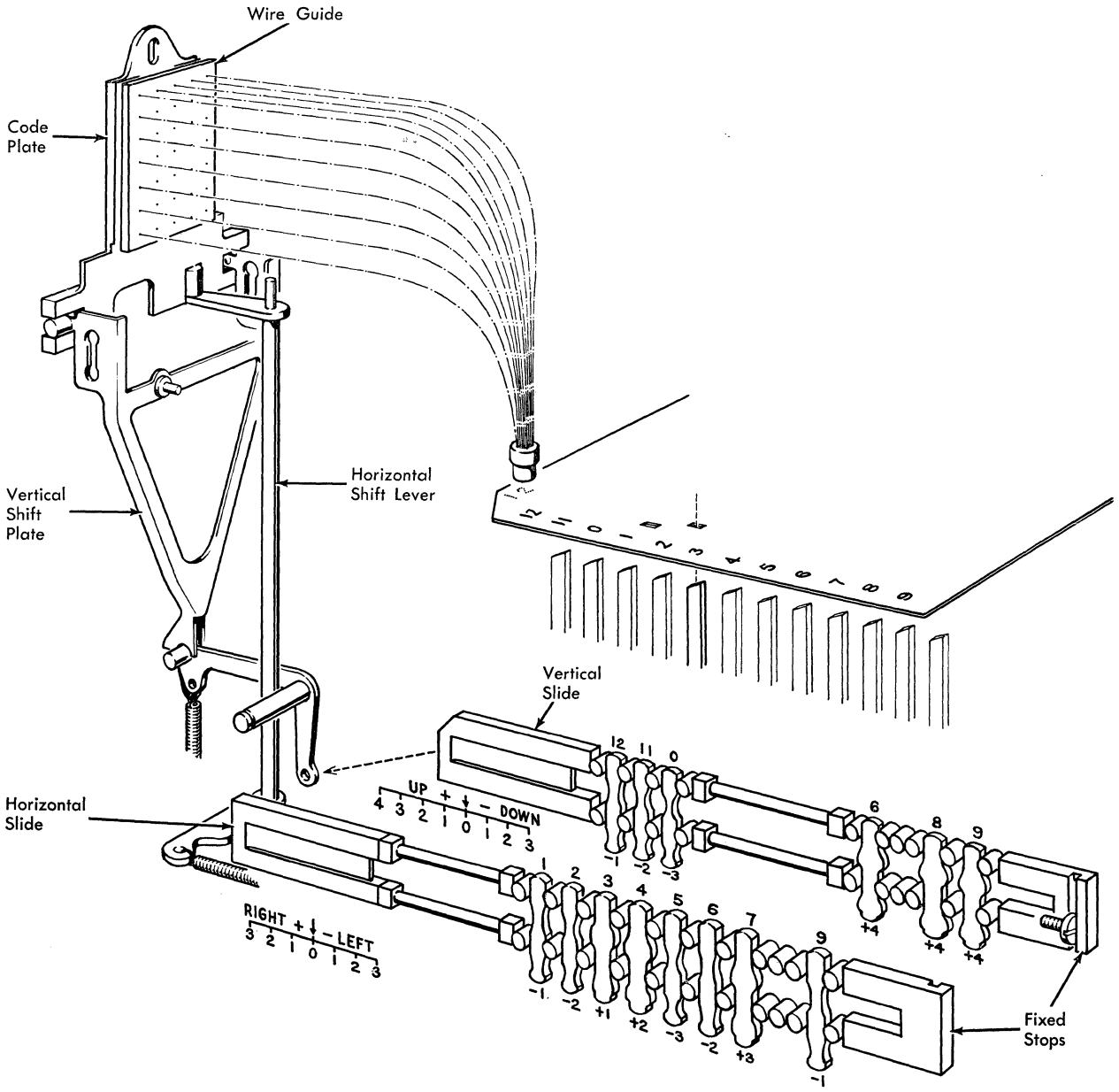


Figure 98. Schematic of Printing

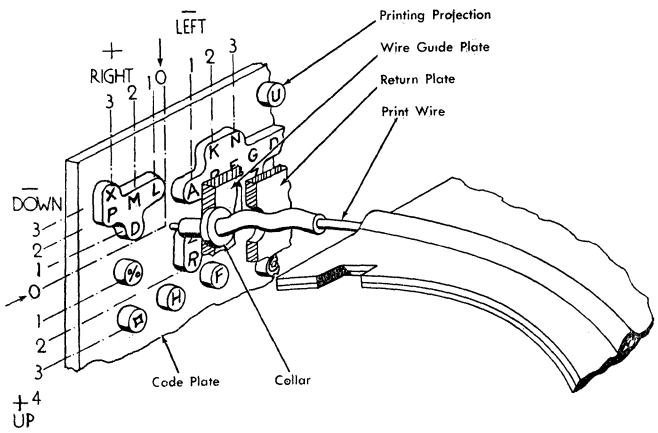


Figure 99. Wire Printing

In Figure 98 the rollers in both sides of the interposer unit are spring tensioned toward their respective fixed stop, (set by adjusting screws). All plus quantities are positively driven by punch power away from the fixed stop. It should also be noted that the 5 punch interposer positions the code plate horizontally only since there is no interposer in the vertical slide assembly for the 5 punch.

For example, the punch code for P is 11 and 7. The 11 punch will move the code plate 2 units down or .044" (Figure 98). The 7 punch also causes the code plate to move but it positions the code plate 3 units to the right or .066".

Now refer to Figure 99 to check the combined results. The print wires are a stationary assembly, there-

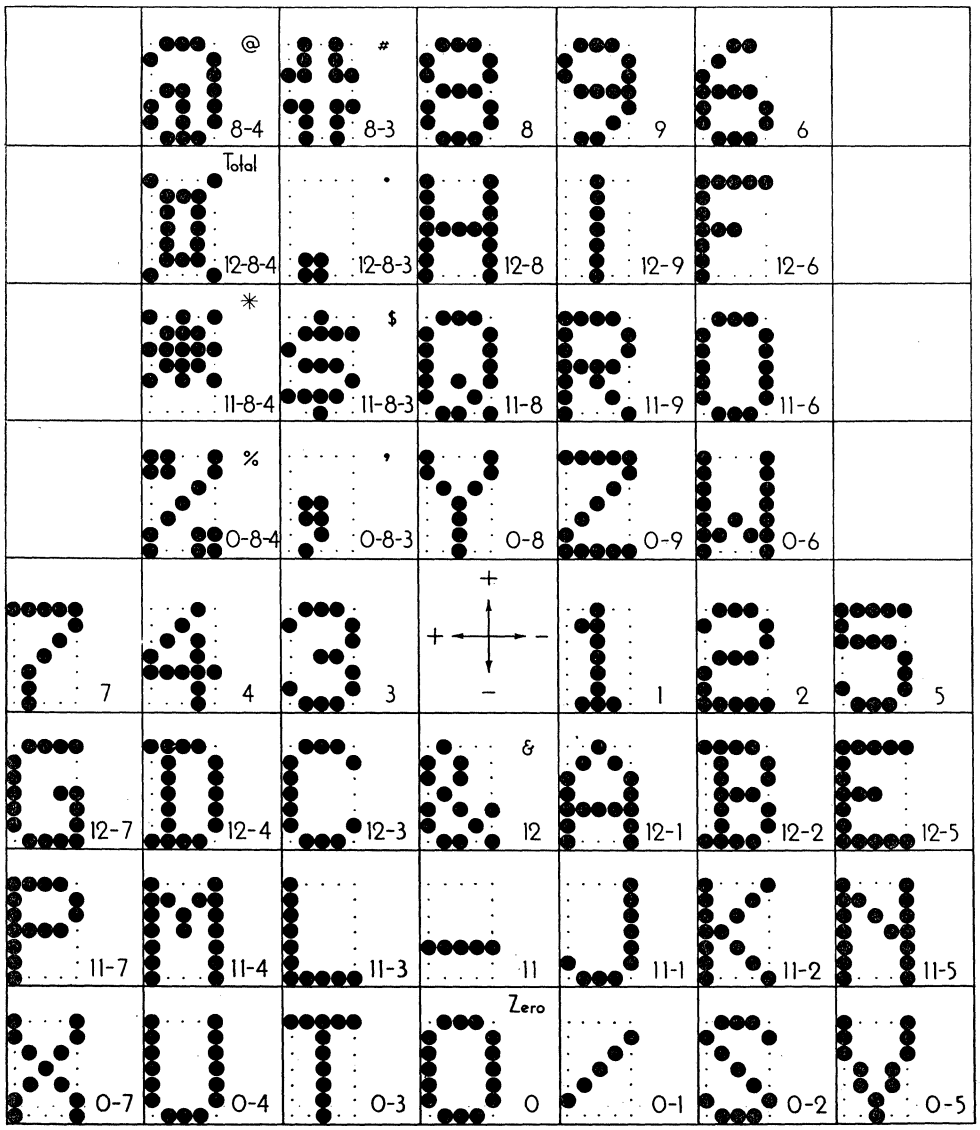


Figure 100. Print Code Chart

fore, to print from an extension on the left of a print wire, the code plate must be shifted to the right. The same explanation applies to vertical placement of extensions. Another point to bear in mind is that the top print wires form the bottom of the letters. The wire shown in Figure 99 is in the upper left-hand corner of the wire guide facing the front of the machine. The 11-7 code which resulted in a code plate shift of right 3, down 2, causes the code plate to strike the wire shown and form the lowest point of the letter P.

The code chart (Figure 100) gives the punch code in small figures for the adjacent characters which will print from these codes.

Pressure Plate (Figure 101)

Through linkage with the print arm, the print cam permits the print arm spring to pull down on the print drive connecting link. This downward motion causes the drive arms to pivot about their stationary shafts and force the pressure plate and code plate against the print wires. The print cam positively restores the pressure plate.

The code plate is repelled from the print wires by a return spring at its top and by two spring driven pressure pins at the bottom. These springs cause the code plate to follow the pressure plate and still permit the code plate to be shifted efficiently.

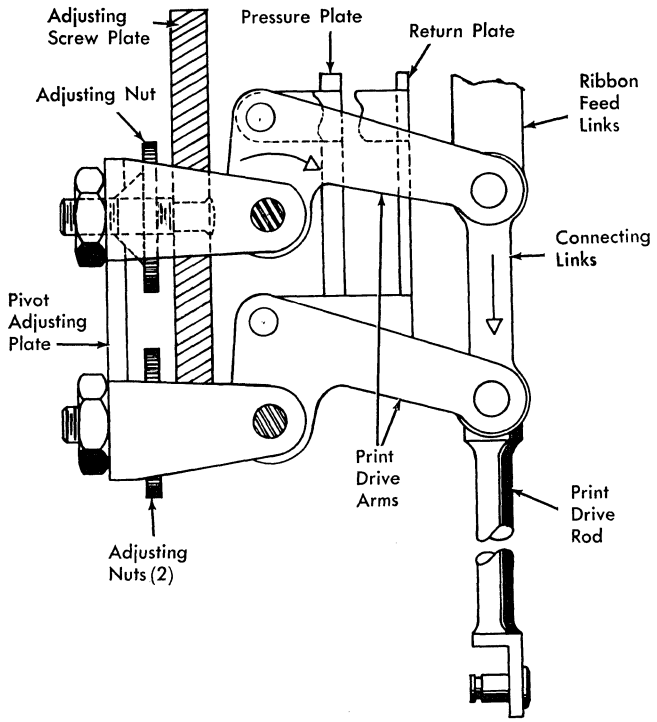


Figure 101. Pressure Plate Operation

Pivot Adjustment Plate

The rest position of the pressure plate is determined and controlled by the pivot adjusting plate (Figure 101). Three knurled adjusting nuts and their associated lock nuts are the means provided to level up the code plate for evenness of impressions. Once the pivot adjusting plate is set for even printing, top to bottom and left to right, lighter or darker impression may be obtained by adding or removing special shims between the pressure plate and the code plate.

Two holes are provided through the pivot adjusting plate, adjusting screw plate, pressure plate and code plate for the insertion of the temporary aligning tool.

Print Suppression (Figure 102)

The print cam is mounted on the punch shaft outside of the punch index. The print arm and suppression arm are mounted on the punch drive anchor pin extension, and the suppression magnet is directly above them.

The print arm, mentioned in the above paragraph, is spring operated and cam restored. To prevent printing, an interposer block on the print suppression magnet armature intercepts the movement of the print arm. The print interposers still continue to shift the code plate but, since the pressure plate is not operated, printing is blocked.

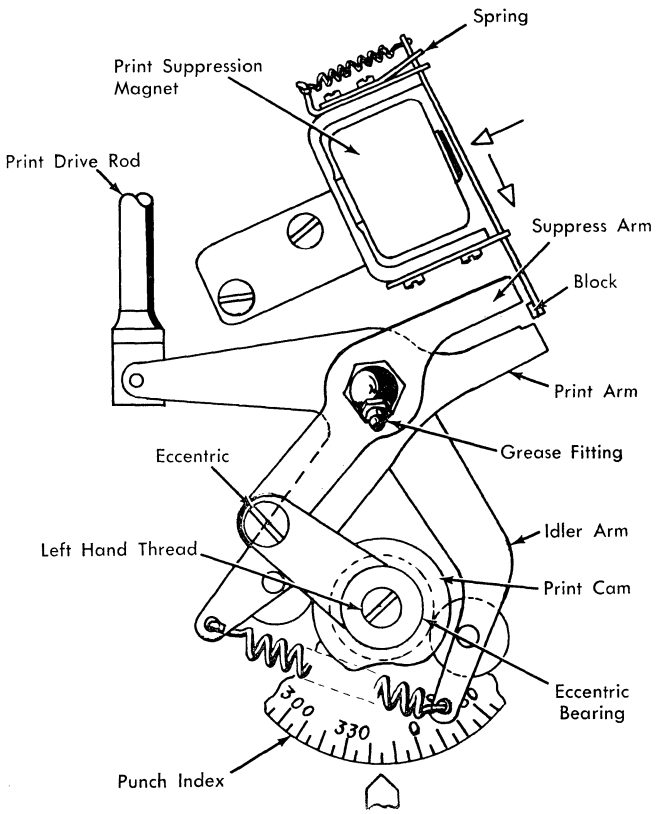


Figure 102. Print Suppression

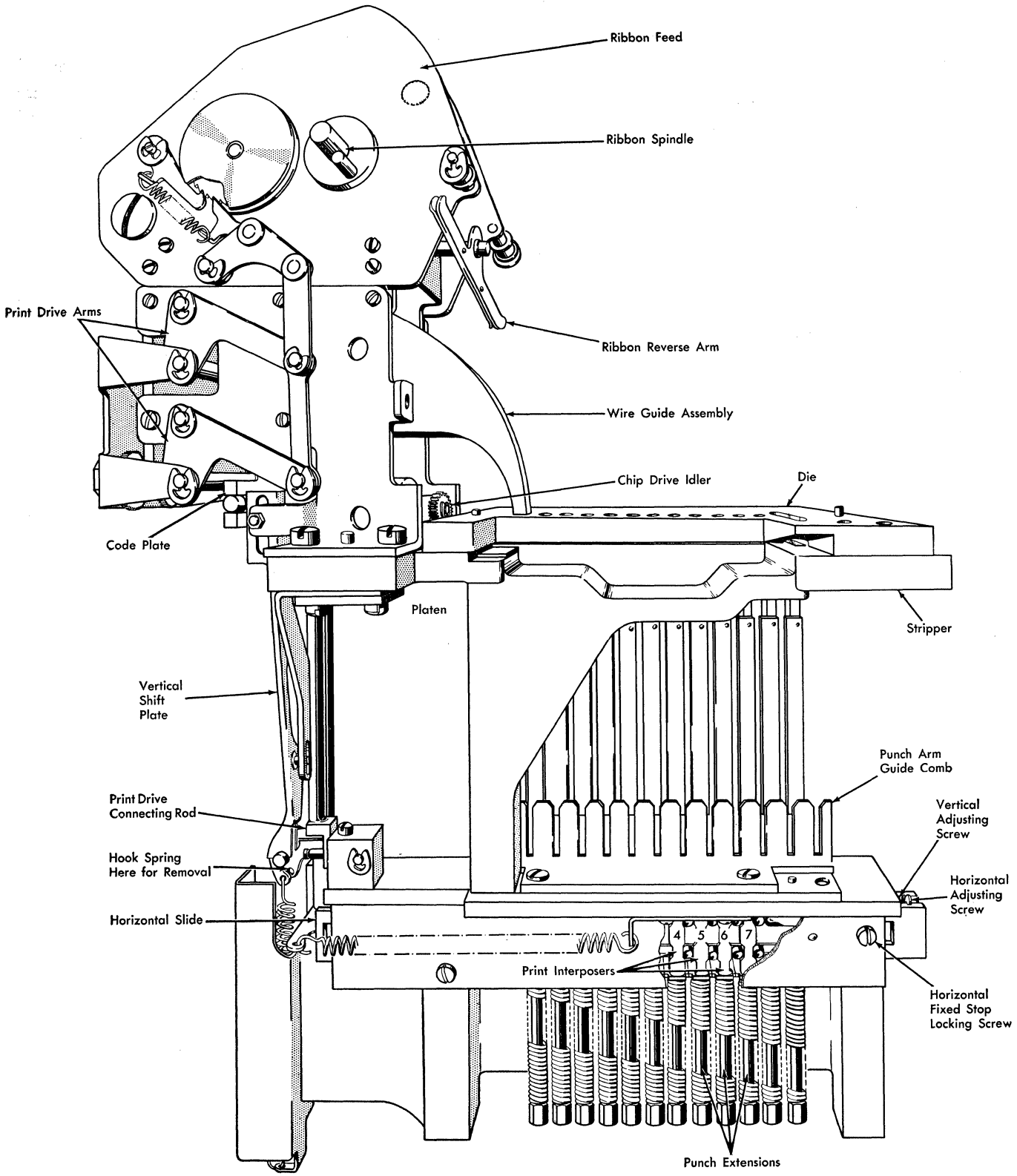


Figure 103. Printing and Punching Combined

The print suppression arm has a reciprocating motion imparted to it by the eccentric drive link and eccentric bearing. The only purpose of the suppression arm is to move the interposer block against the print arm thus lifting the print arm roller off the print cam. The suppression arm and linkage is a noise reducing feature which prevents the print arm follower from bouncing on the approach to the high dwell of the print cam.

This feature also eliminates the close clearance that would be necessary between the interposer block and print arm.

Suppression Magnet

The high speeed print suppression magnet is under control of the print switch or the 3 hole in the program card. Its armature travels at right angles to the yokes because of the suppression arm. A flat spring causes the armature to return against the stop at the spring end of the armature.

Punch Drive Unit

Several minor variations exist between the punch units of the Types 24 and 26 machines. On the Type 26 Printing Card Punch, the punch interposer magnets 1 through 9 have less resistance since they operate in series with the windings of print R31. With the special characters feature, the common to these magnets is broken and a rectifier is used to eliminate back circuits as described under *Circuit Description.*

The entire printing mechanism is shown removed from the machine and reassembled in Figure 103. The wire guide funnels the print wires into a hardened steel insert in the die. The print drive connecting rod (also shown in Figure 101) operates the ribbon feed pawls in addition to the print drive arms and the pressure plate.

The ribbon feed mechanism is removable from the top of the printing head. The printing head is also easily removed from its mounting on the rear of the stripper frame.

With reference to Figure 104, notice that the punch has traveled far enough to strike the card before the print cam operates. By the time the punch strikes the card, the print interposers have completely shifted the code plate so that the only motion of the code plate while printing is toward the wires.

The code plate is retracted from the print wires while the punches are still at their highest point of travel. The code plate returns to its home position after each printing operation. Thus, it can be seen that the code plate is free of the wires before it is returned to the home position which occurs when the punches are lowered.

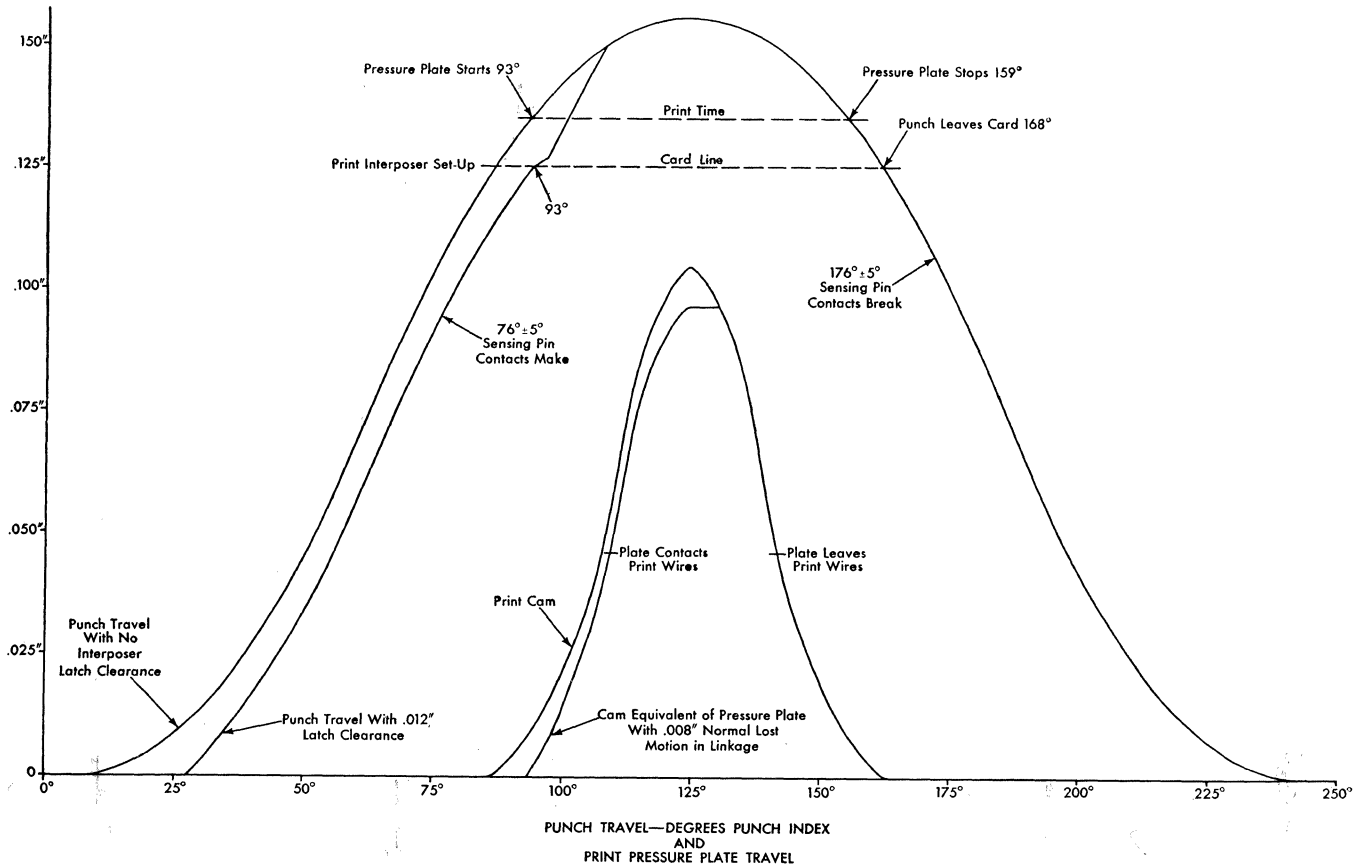


Figure 104. Mechanical Sequence Chart—Printing

Code Plate Alignment (Figure 105)

With the machine turned OFF and the punch clutch latched up, the temporary aligning tool should be inserted in the two channels provided in the back of the pivot adjusting plate through the code plate without difficulty.

To adjust, loosen the locking screws on the print interposer vertical and horizontal fixed stops and adjust the vertical and horizontal adjusting screws until the aligning tool inserts easily. Tighten the locking screws.

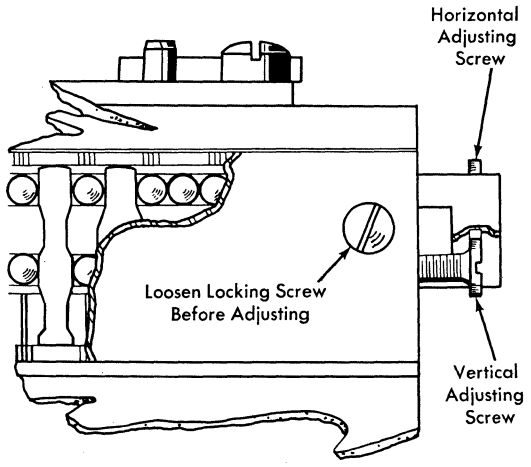
CAUTION: The temporary aligning tool must be removed before the machine is operated.

Even Impression Adjustment (Figure 106)

Adjust the three knurled adjusting nuts individually to obtain an even impression from top to bottom and side to side for all letters. Bring up the lock nuts. This adjustment is not used for lighter or darker impressions of printing.

Impression Adjustment (Figure 106)

After the above adjustment has been completed, a darker or lighter impression can be obtained by adding or removing special shims between the pressure plate and the code plate. When adjusting for dark impression, be certain to check .015″ minimum clearance from the code plate projections to the ends of the print wires. Check over the entire area of the code plate.



Figur 105. Code Plate—Alignment Adjustment

Print Suppression Adjustment (Figure 107)

1. Position the two armature stops on the print suppression magnet to permit the armature to strike the yoke ends.

2. The armature return spring should have sufficient tension to hold the armature against the stop at the armature spring end.

3. By means of the left-hand threaded eccentric bearing screw, position the eccentric bearing so that the groove on its surface lines up with the groove on the print cam (insert Figure 107).

4. With the print suppression magnet properly adjusted, attract the armature to the yoke and position the magnet mounting bracket so that the armature contacts the print suppression arm end and clears the print arm with the interposer block by .003″ to .005″. It may be necessary to adjust the eccentric stud in the eccentric link to position the interposer block between the arms.

5. Adjust the eccentric stud in Figure 107 to clear the interposer block on the suppression magnet armature by .024″ to .026″. Check that the print suppression armature is free to slide across the yokes as this motion is essential to move the print arm roller off the print cam.

In Figure 101 notice that the print wire return plate and the pressure plate are both mounted and operated by the same shafts. This means that the distance between them is fixed.

There must be a clearance between the wire guide plate and the return plate because the eccentric bearing and link cause the pressure plate to move as well as the return plate. The .015″ clearance is needed to prevent the code plate from catching on the print wires when the return plate brings the print wire collars against the guide plate. The .024″ to .026″ clearance at the interposer block is important to maintain. The print suppression arm should raise the print arm roller about .010″ off the print cam. Any excessive travel of this arm will seriously affect the movement of the pressure and return plate. Adjustments made to overcome printing failures should be made with these relationships in mind.

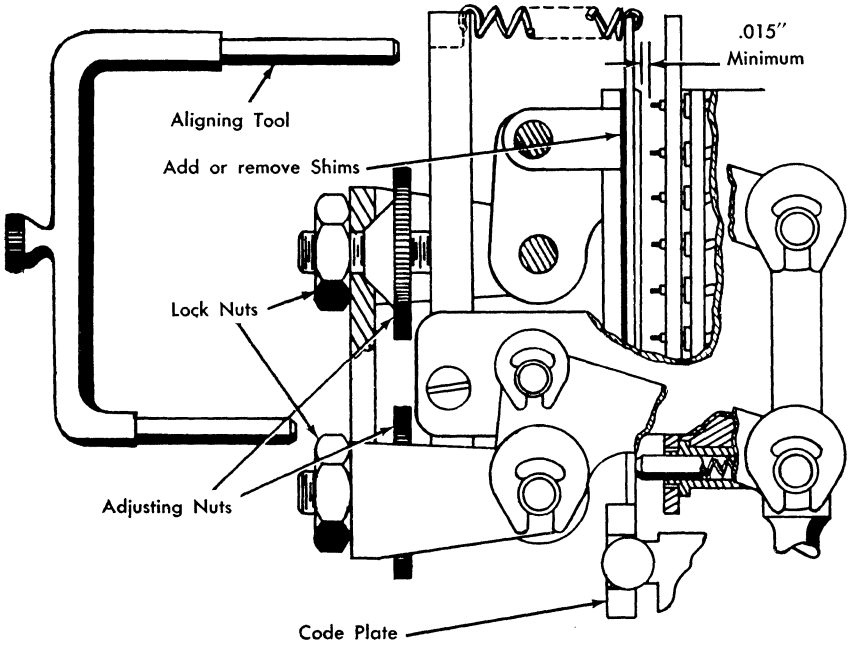


Figure 106. Printing Adjustment

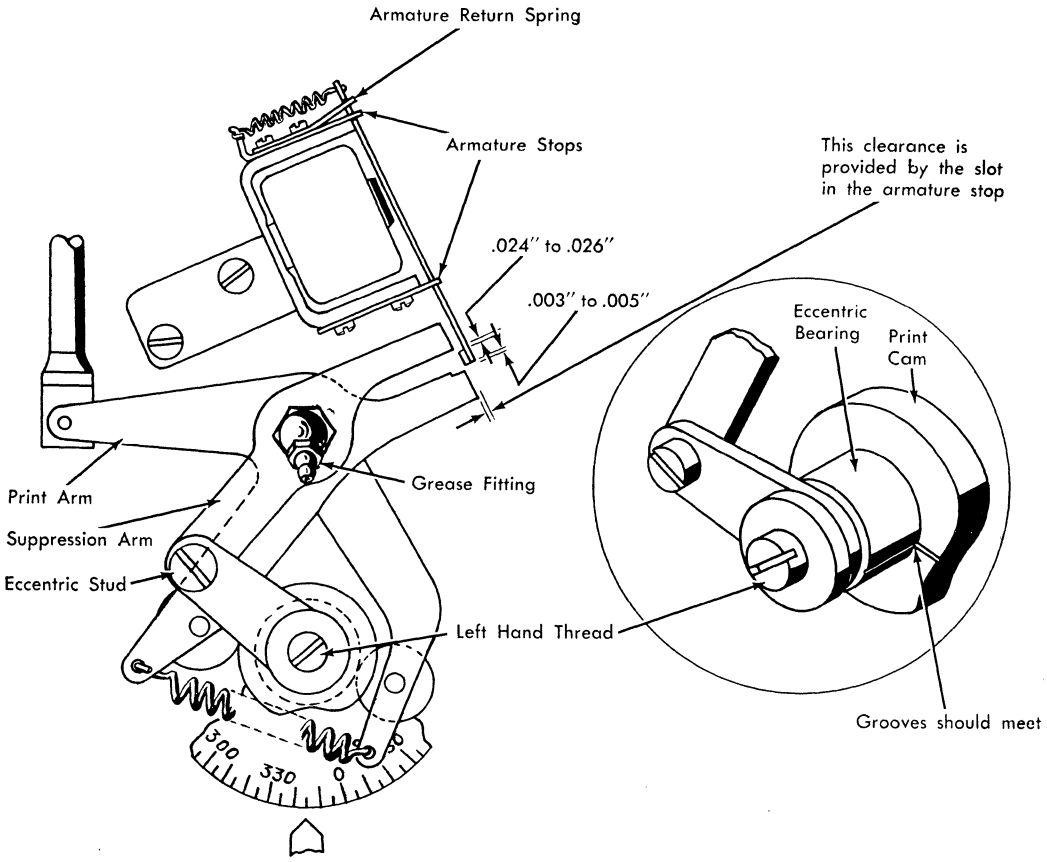


Figure 107. Print Suppression Adjustment

Installation of Ribbon

The ribbon should be installed from the right to the left of the die because the taper of the die in that direction makes it easier. Place the loaded spool on the ribbon spindle and proceed as follows:

1. Thread the loose end of the ribbon (the end without the hook) through the die and stripper at the center of the die. Below the 9 position it is recessed to provide for the ribbon eyelet. The release arm must be operated to permit passage of the ribbon eyelet between the pressure roll and the punch feed roll.

2. Install the full spool on its spindle with the ribbon leaving from the top of the spool, toward the front of the machine.

3. Tie a knot in the end of the ribbon already passed through the die and stripper, and insert this knot in the slot of an empty ribbon spool with the ribbon entering at the top of the spool toward the front of the machine.

4. Be sure the ribbon is positioned in the groove provided for it in the die above the 12 punch.

5. Take up the slack and thread the ribbon through the guides and reverse arms. So long as the spools are installed to rotate properly (feeding from the top) the guides will correct the twist in the ribbon.

Type 26 Printing Card Punch Lubrication

1. Oil the print suppression eccentric bearing and stud with IBM 8.

2. To provide adequate lubrication and prevent corrosion use IBM 6 on all moving parts of the print unit except the print wires which should be left dry.

3. Grease the print arm operating stud with IBM 22.

4. Grease the fitting in the punch drive rear mounting plug with IBM 22.